
STORMWATER MANAGEMENT REPORT

for

**ONE PARK
27 Park Road
West Hartford, Connecticut**

Prepared for:

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October 2018
140184201

LANGAN

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EXECUTIVE SUMMARY

This stormwater management report has been prepared in support of the proposed One Park development to be located at 27 Park Road in the town of West Hartford, Hartford County, Connecticut. The development includes construction of a five-story residential building. This proposed building will connect to existing residential buildings that are to remain. Site improvements include a pool and pool house, parking, driveways, walkways, utilities, drainage, and landscaping.

The site is ± 21 acres with the proposed development to encompass approximately half the site. The site is bordered by Park Road to the north, Prospect Avenue to the east, Kennedy Memorial Park to the south, and Ringgold Street to the west (see Figure 1). The existing site grades range from approximately el. 42 to el. 79, with the majority of the development taking place above elevation 45.

Hydrologically, the site is located in the South Branch Park River Sub-regional Watershed. The South Branch Park River Sub-regional Watershed is approximately 25,400 acres, of which the site encompasses a nominal amount of total watershed area. Stormwater runoff from the site is either collected in on-site drainage structures which eventually discharge to an on-site wetland or flows overland to the town drainage systems within Park Road and Prospect Avenue. Parts of the site are located in the FEMA Flood Zone X (Shaded) and Flood Zone A (See Figure 2).

The proposed stormwater management system has been designed in accordance with the town of West Hartford Design Requirements; guidance provided by the West Hartford Engineering Department, the 2004 Stormwater Quality Manual, and the 2000 CT DOT Drainage Manual. The system incorporates significant stormwater quality measures and maintains or decreases the rate of runoff for all storms analyzed.

It is the opinion of this office and the findings of this report that the proposed stormwater system, as designed, will effectively manage the stormwater runoff for quality and quantity for the proposed development.

1.0 INTRODUCTION

1.1 General

This stormwater management report has been prepared in support of the proposed One Park development to be located at 27 Park Road, West Hartford, Connecticut. This report addresses the engineering design of the stormwater conveyance and management systems for the site.

1.2 Site Location

The development is located on a ±21-acre property bordered by Park Road to the north, Prospect Avenue to the east, Kennedy Memorial Park to the south and Ringgold Street to the west (see Figure 1).

1.3 Existing Conditions

The site is developed with existing buildings partially occupied by the Sisters of St. Joseph. Areas outside of the buildings include parking areas, lawn, and two (2) wetland areas. An isolated wetland area exists near the southern property line while a larger wetland area (hereon in known as "wetland") contains an existing watercourse located to the south and west of the development. Existing grades on site range from approximate el. 42 to el. 79, with the majority of the development taking place above elevation 45.

1.4 Project Description

The development includes construction of a five-story residential building. Site improvements include a pool and pool house, parking, driveways, walkways, utilities, drainage, and landscaping.

1.5 FEMA

According to the Flood Insurance Study of Hartford County, Connecticut conducted by the Federal Emergency Management Agency (FEMA), parts of the site are in the FEMA Flood Zone X and Flood Zone A (See Figure 2).

Zone A is an area subject to inundation by the 1 percent annual chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no base flood elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

Zone X is considered a Moderate Risk Area and described by FEMA as areas of areas within the 0.2 percent, annual, chance floodplain; areas of 1-percent, annual, chance flooding where average depths are less than 1 foot; areas of 1-percent, annual chance flooding where the contributing drainage area is less than 1 square mile; and areas protected from the 1 percent, annual, chance flood by a levee. No base flood elevations or base flood depths are shown within these zones.

1.6 Soil Conditions

According to the USDA Natural Resources Conservation Service Web Soil Survey, the site soil type is predominantly Udorthents – Urban land complex (See Figure 3). The Web Soil Survey has classified these soils as soil Group B and C.

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
28A	Elmridge fine sandy loam, 0 to 3 percent slopes	12.8	5.0%
225B	Brancroft-Urban land complex, 0 to 8 percent slopes	16.6	6.5%
228B	Elmridge-Urban land complex, 0 to 8 percent slopes	45.3	17.6%
240B	Ludlow-Urban land complex, 0 to 8 percent slopes	0.5	0.2%
304	Udorthents, loamy, very steep	4.4	1.7%
306	Udorthents-Urban land complex	58.4	22.7%
307	Urban land	102.9	40.1%
308	Udorthents, smoothed	15.9	6.2%
Totals for Area of Interest		256.8	100.0%

Table 1: NRCS Soil Survey

A summary of the basic characteristics of the soils series present on site are outlined below:

Udorthents-Urban Land Complex (306) - The Urban Land series consists of nearly level and gently sloping excavated and filled land for construction projects. Permeability is moderately rapid in the subsoil and rapid in the substratum. Available water capacity is moderate.

Urban Land (307) - The Urban Land series consists of nearly level and gently sloping excavated and filled land for construction projects. Available water capacity is low.

Soils are classified into hydrologic soil groups (HSG) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSGs, which are A, B, C and D, are one element used to determine runoff curve numbers and analyzing stormwater characteristics of a site.

Group A soils have a high infiltration rate (low runoff potential) when thoroughly wet. These consist of mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B soils have a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C soils have a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D soils have a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D) the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

2.0 STORMWATER MANAGEMENT

2.1 Design Criteria

Proposed peak flow rates at all points of discharge from the site were analyzed to compare proposed discharge rates with the existing condition.

The storms analyzed include the following:

- A 2-year, 24-hour storm consisting of 3.30 inches of rainfall
- A 10-year, 24-hour storm consisting of 5.30 inches of rainfall
- A 25-year, 24-hour storm consisting of 6.54 inches of rainfall
- A 100-year, 24-hour storm consisting of 8.46 inches of rainfall

These events are based on the West Hartford rainfall data obtained by NOAA.

2.2 Design Methodology

The peak runoff discharges for the existing and proposed conditions were analyzed using Soil Conservation Service (SCS) methodology, which outlines procedures for calculating peak rates of runoff resulting from precipitation events, and procedures for developing runoff hydrographs. Values for area, curve number and time of concentration were calculated for the existing and proposed conditions.

The curve number “CN” is a land-sensitive coefficient that dictates the relationship between total rainfall depth and direct storm runoff. The soils within the watershed are divided into hydrologic soil groups (A, B, C and D). The SCS classification system evaluates the runoff potential of a soil according to its infiltration and transmission rates. “A” soils have the lowest runoff potential, and “D” soils have the greatest runoff potential. Soils within the development area predominantly have a hydrologic soil group designation of “B” and “C.”

The time of concentration, T_c , is defined as the time for runoff to travel from the hydraulically most distant point in the watershed to a point of interest. Values of time of concentration were determined for existing and proposed conditions based on land cover and slope of the flow path, using methods outlined in the SCS methodology.

For this study, a 24-hour SCS Type III standard rainfall distribution was used to determine the peak flow rate to all points of discharge from the site.

2.3 Existing Runoff Discharges (See Appendix A for Calculations)

The existing drainage conditions were delineated in three (3) watershed areas: A, B and C (See EX-WS).

Watershed A, consisting of ± 10.43 acres, comprises the majority of the site as well as the existing building, parking lot, and part of the existing lawn area south of the building. Runoff from this watershed flows directly into the on-site wetland.

Watershed B, consisting of ± 1.43 acres, comprises part of the existing building, parking lot and lawn area at the north of the property near Park Road. Runoff from this watershed flows into Park Road, drains west into existing catch basins on Park Road. These catch basins convey collected runoff through a 15-inch reinforced concrete pipe (RCP) into the 18-inch RCP town drainage system.

Watershed C, consisting of ± 0.15 acres, comprises primarily of landscaped grass and vegetation along Prospect Avenue. Stormwater runoff from this watershed flows into an existing catch basin located in Prospect Avenue. This catch basin conveys collected runoff through a 12-inch reinforced concrete pipe (RCP) into the town drainage system.

2.4 Proposed Runoff Discharges (See Appendix B for Calculations)

The proposed development area has been delineated into three watershed areas A, B, and C. These watersheds contribute to the same analysis points as described in section 2.3 above. To accurately model and route the proposed runoff through the various stormwater management features, the watersheds have been further divided and combined into sub-watersheds labeled A-1, A-2, A-3, B, and C (See PR-WS).

Watershed A-1, ± 3.44 acres, comprises most of the existing building's roof and most of the northern portion of the site, including the interior courtyard areas between the existing and proposed buildings. Stormwater from this watershed will be collected in on-site catch basins and conveyed by a closed pipe network into the proposed underground detention system #1 within the parking area in the western portion of the site. An outlet control structure has been designed to manage discharge flow rates to the existing on-site wetland.

Watershed A-2, ± 4.62 acres, comprises the remainder of the existing building and all of the proposed building roof areas, existing lawn areas on the eastern portion of the site, and the southern parking area. Stormwater from this watershed will be collected in on-site catch basins and conveyed by a closed pipe network into the proposed underground detention system #2 located within the parking area in the southern portion of the site. An outlet control structure

has been designed to manage discharge flow rates to the existing on-site wetland.

Watershed A-3, ± 3.46 acres, is composed of the site's western and southern landscaped area directly upstream of the wetland. This area is to remain mostly undisturbed except for a small portion adjacent to Prospect Avenue where the compensatory storage for the site's floodplain will be located. Stormwater runoff from this watershed sheet flows down the vegetated slope directly into the on-site wetland.

Watershed B, consisting of ± 0.38 acres, is composed of the northern landscaped area adjacent to Park Road. This watershed will remain mostly unchanged from existing conditions. Runoff from this watershed flows into Park Road and drains west into existing catch basins on Park Road. These catch basins convey collected runoff through a 15-inch reinforced concrete pipe (RCP) into the 18-inch RCP town drainage system.

Watershed C, ± 0.11 acres, is comprised of the eastern landscaped area adjacent to Prospect Avenue. This watershed will remain mostly unchanged from existing conditions. Stormwater runoff from this watershed will continue to flow into an existing catch basin on Prospect Avenue. This catch basin conveys collected runoff through a 12-inch reinforced concrete pipe (RCP) into the town drainage system.

Table 2: Peak Runoff Flow Comparison (CFS)

	2-YEAR		10-YEAR		25-YEAR		100-YEAR	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Drainage to Wetland (WS-A)	11.07	7.55	26.67	25.98	37.15	36.12	53.82	51.54
Drainage to Park Road (WS-B)	1.90	0.43	4.36	1.12	5.98	1.59	8.54	2.35
Drainage to Prospect Ave. (WS-C)	0.15	0.18	0.41	0.40	0.59	0.54	0.89	0.77
Total Site Discharge	12.99	7.78	31.13	26.85	43.26	37.53	62.66	53.57

Although the development results in an increase to the impervious cover of the site, the stormwater management system has been designed to provide peak-flow attenuation and result in a decrease in peak discharge rates between pre- and post-development conditions.

Our opinion is that the stormwater management system, as designed, will have no impact on the function of the existing on-site wetland or the town drainage system.

3.0 STORMWATER QUALITY

3.1 Stormwater Quality Improvements

The stormwater management system has been designed in accordance with the Connecticut DEP Stormwater Quality Manual and the Connecticut DEP Soil Erosion and Sediment Control Manual. The underground detention chambers have been designed to accept stormwater runoff from the roof and majority of the developed area. To provide pretreatment of stormwater entering the two detention system inlets, two filter fabric wraps, Isolator Rows®, have been provided to enhance the removal of Total Suspended Solid (TSS). Calculations have been provided for the sizing of each of these Isolator Rows® (See Appendix D).

3.2 Additional Stormwater Quality Features

In addition to the Isolator Rows® described above, the following additional water-quality control measures will be provided:

Catch basins with sumps: Catch basins at the site are to be constructed with sumps (minimum 2 feet) to prevent discharge of sediments. Catch basins will be cleaned two times per year.

4.0 STORM DRAINAGE COLLECTION SYSTEM DESIGN (See Appendix C for Calculations)

4.1 Design Criteria

The proposed subsurface storm drainage collection system is designed to convey the 10-year design storm event per the Town of West Hartford requirements. The isolated yard drain enclosed in the courtyard with no overland free-flow release has been designed to convey the 100 year storm event. All underground conveyance networks have been designed with 1 foot of freeboard between the HGL and the top of structure frames.

4.2 Design Methodology

The storm-drainage system was analyzed using the Rational Method for estimating runoff for a 10-year design storm event. The site was divided into subareas, each contributing runoff to an individual catch basin inlet or roof drain. A value for area, time of concentration, and a runoff coefficient was calculated for each contributing subarea.

Values of time of concentration were chosen based on land cover and slope of the flow path from the hydraulically most distant point in the subarea to the appropriate inlet. The average runoff coefficient, which is the ratio of peak runoff rate to the average rainfall rate for the period known as the time of concentration, was chosen using the following values:

CONDITION	C
Grass/Landscaping	0.30
Paved/Impervious	0.90
Roof Areas	0.95

Rainfall intensities were taken from the intensity-duration-frequency curve for Connecticut as presented in the Connecticut DOT Drainage Manual, 2000. Storm-drainage pipes were then sized based on calculated flows using Manning's Equation and were verified by solving for the hydraulic grade line. Starting hydraulic grade lines for the pipe networks were set to the calculated

maximum water elevations for the 10-year-design storm event within the analyzed drainage network.

4.3 Storm Drainage Collection Summary

The runoff from the development will be collected using conventional roof drains, catch basin, and manhole system. The collection system was designed to convey the 10-year storm with a 1 foot free board before overtopping any of the proposed catch basins on site. The enclosed courtyard drainage has been designed based on assumed 100% impervious surface and for conveyance of a 100 year design storm.

In addition, the main “trunk” line of the system has been analyzed without taking into consideration the flow attenuation from the underground system in order to ensure pipes have capacity in the event of a problem with the underground detention systems.

5.0 CONCLUSION

The proposed stormwater management system has been designed in accordance with the town of West Hartford Design Requirements, guidance provided by the town of West Hartford Engineering Department, the 2004 Stormwater Quality Manual, and the 2000 CT DOT Drainage Manual. The system incorporates significant stormwater quality measures and maintains or decreases the rate of runoff for all storm events analyzed.

It is the opinion of this office and the findings of this report that the proposed stormwater system, as designed, will effectively manage the stormwater runoff for quality and quantity for the proposed development.

6.0 REFERENCES

1. Town of West Hartford Zoning Regulation
2. Connecticut Guidelines for Soil Erosion and Sediment Control, The Connecticut Council on Soil and Water Conservation, 2002.
3. Soil Survey of Hartford County, Connecticut, United States Department of Agriculture, 1958.
4. Urban Hydrology for Small Watersheds, Technical Release 55, United States Department of Agriculture, Soil Conservation Service, June 1986.
5. Connecticut Stormwater Quality Manual, Connecticut Department of Environmental Protection, 2004.

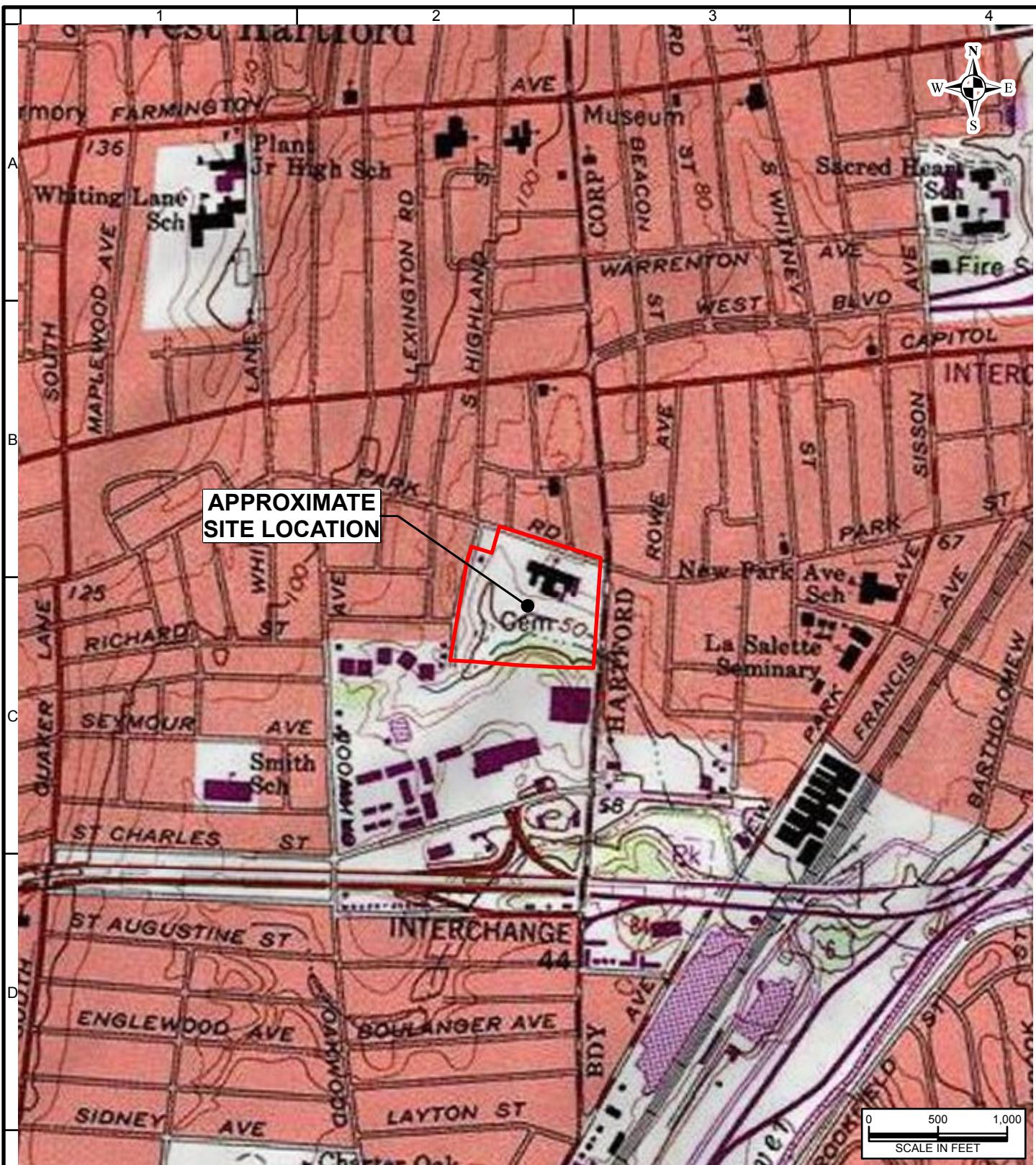
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| EX-WS | Existing Drainage Area Plan |
| PR-WS | Proposed Drainage Area Plan |
| DA-CB | Catchment Area Map |



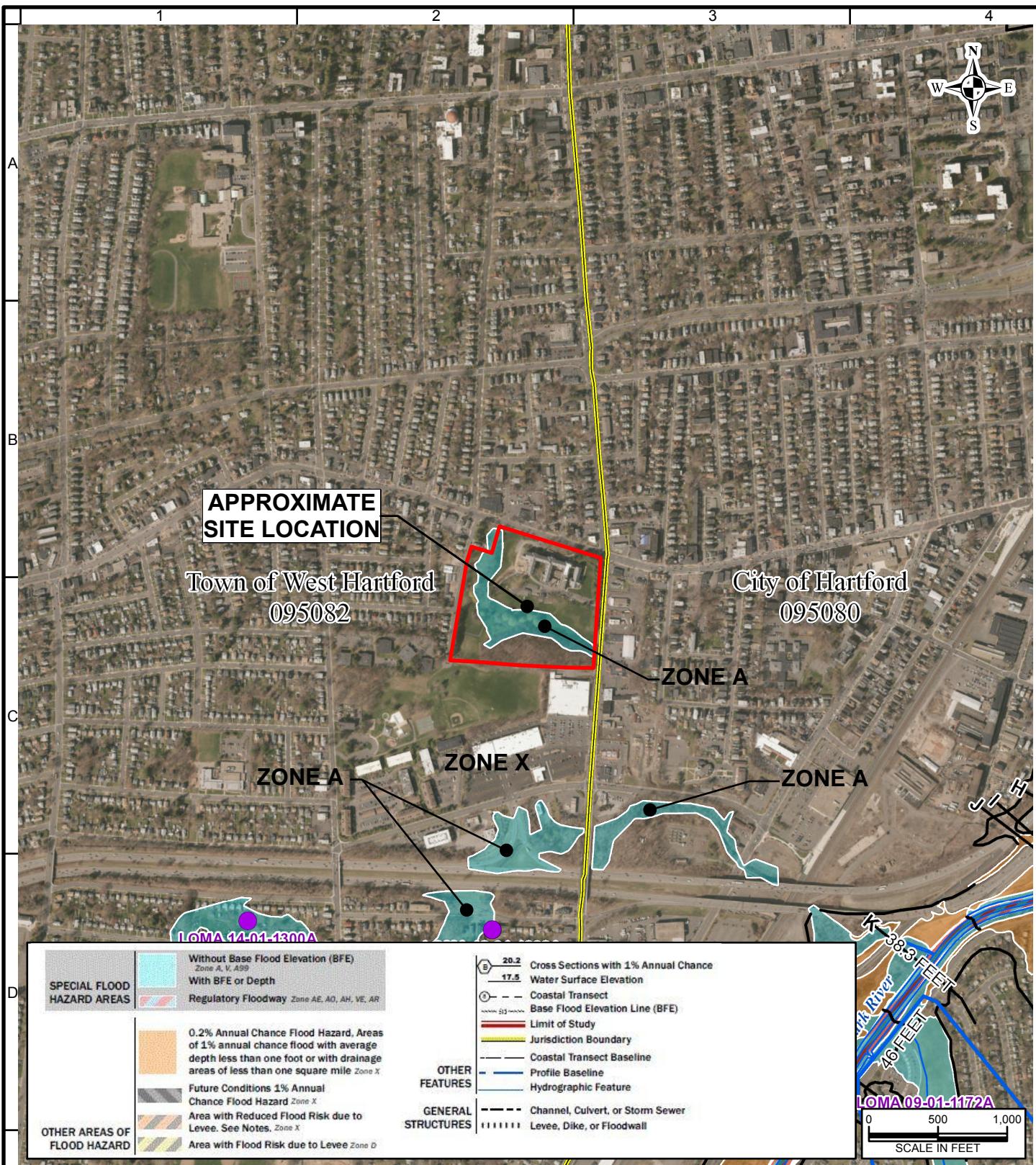
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N.J. CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project ONE PARK
WEST HARTFORD CONNECTICUT

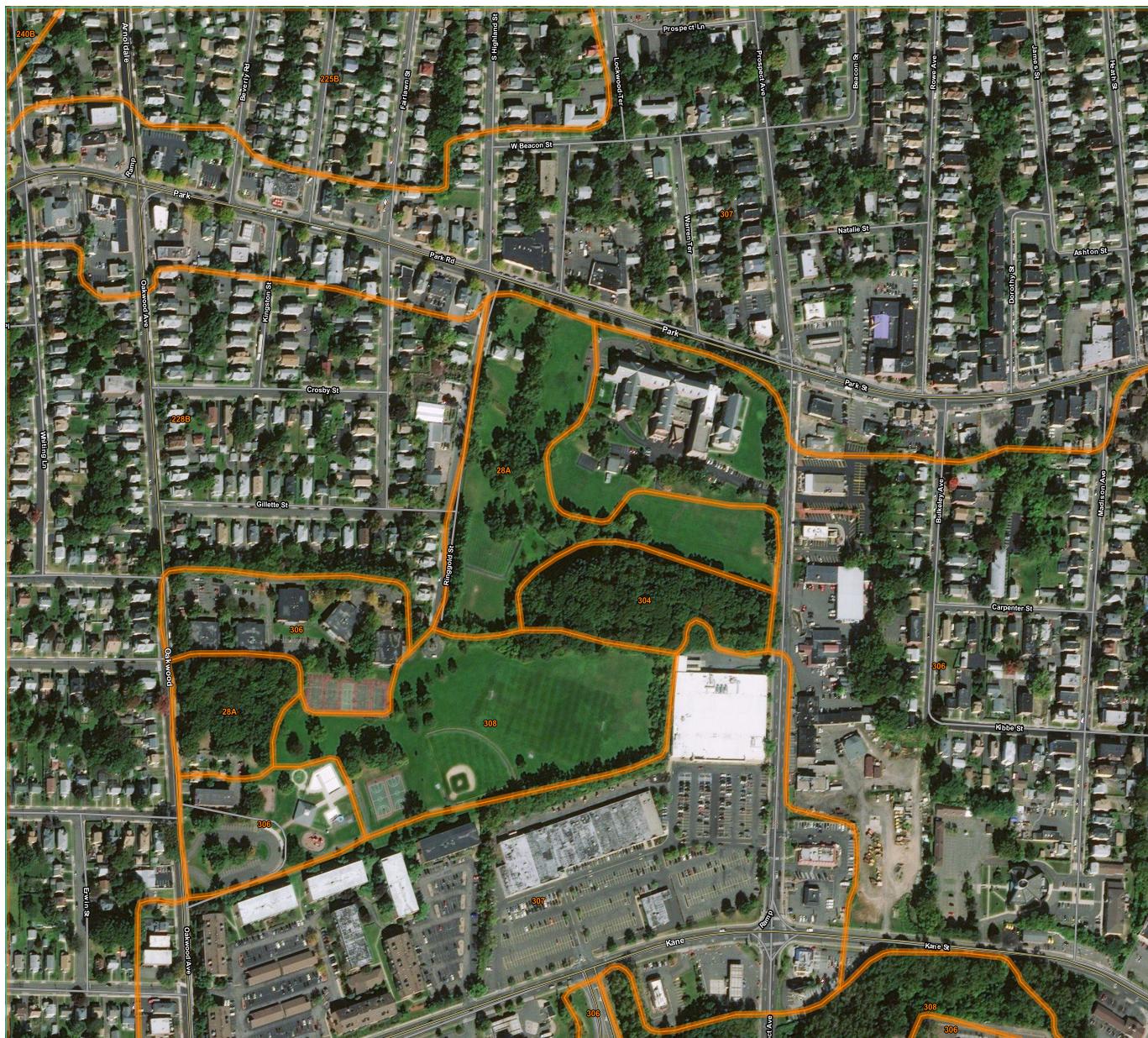
USGS LOCATION MAP
Spatial Reference: NAD 1983 StatePlane Massachusetts Island FIPS 2002 Feet

Project No. 140184201	Figure 1
Date 8/15/2018	
Scale 1:1,000	
Drawn By Site Analyzer	
Submission Date 08/15/2018	Sheet 1 of 3



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NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400	

ONE PARK	FEMA MAP	Project No. 140184201	Figure 2
WEST HARTFORD	Spatial Reference: NAD 1983 StatePlane Massachusetts Island FIPS 2002 Feet	Date 8/15/2018	
CONNECTICUT		Scale 1:1,000	
		Drawn By Site Analyzer	
		Submission Date 08/15/2018	Sheet 2 of 3



D MAP UNIT SYMBOL

28A
225B
228B
240B
304
306
307
308

D MAP UNIT NAME

Elmridge fine sandy loam, 0 to 3 percent slopes
Bancroft - Urban land complex, 0 to 8 percent slopes
Elmridge - Urban land complex, 0 to 8 percent slopes
Ludlow - Urban land complex, 0 to 8 percent slopes
Udorthents, loamy, very steep
Udorthents - Urban land complex
Urban Land
Udorthents, smoothed

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Project

ONE PARK

WEST HARTFORD CONNECTICUT

SOILS MAP

Spatial Reference: NAD 1983 StatePlane Massachusetts
Island FIPS 2002 Feet

Project No.
140184201

Date
8/15/2018

Scale
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Drawn By
NCW

Submission Date
08/15/2018

Figure

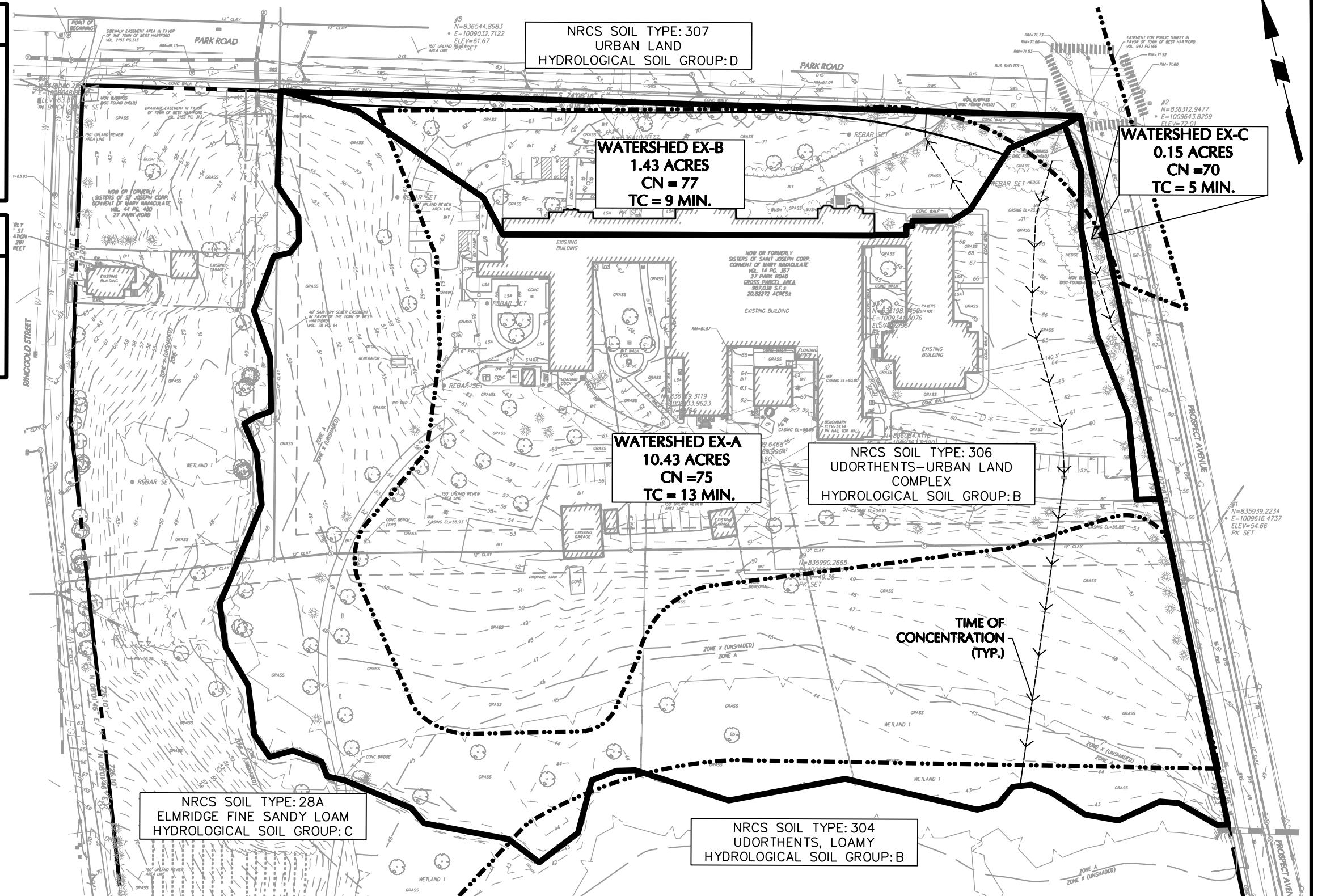
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GENERAL NOTES

- EXISTING BOUNDARY & TOPOGRAPHIC INFORMATION OBTAINED FROM A MAP TITLED "BOUNDARY & TOPOGRAPHIC SURVEY" PREPARED BY LANGAN ENGINEERING & ENVIRONMENTAL SERVICES, DATED OCTOBER 26, 2018.
- THE SITE CONTAINS AREAS WITHIN ZONE "A" FLOODPLAIN PER FIRM MAP #09003C0364F, EFFECTIVE SEPTEMBER 26, 2008.

LEGEND

- A
WATERSHED BOUNDARY
- B
TIME OF CONCENTRATION
- C
SOIL BOUNDARY



100 0 50 100
SCALE IN FEET

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Project

ONE PARK

WEST HARTFORD CONNECTICUT

Drawing Title

**EXISTING
DRAINAGE
AREA PLAN**

Project No.	140184201
Date	12/06/2108
Scale	1"=100'
Drawn By	IV
Checked By	NLK

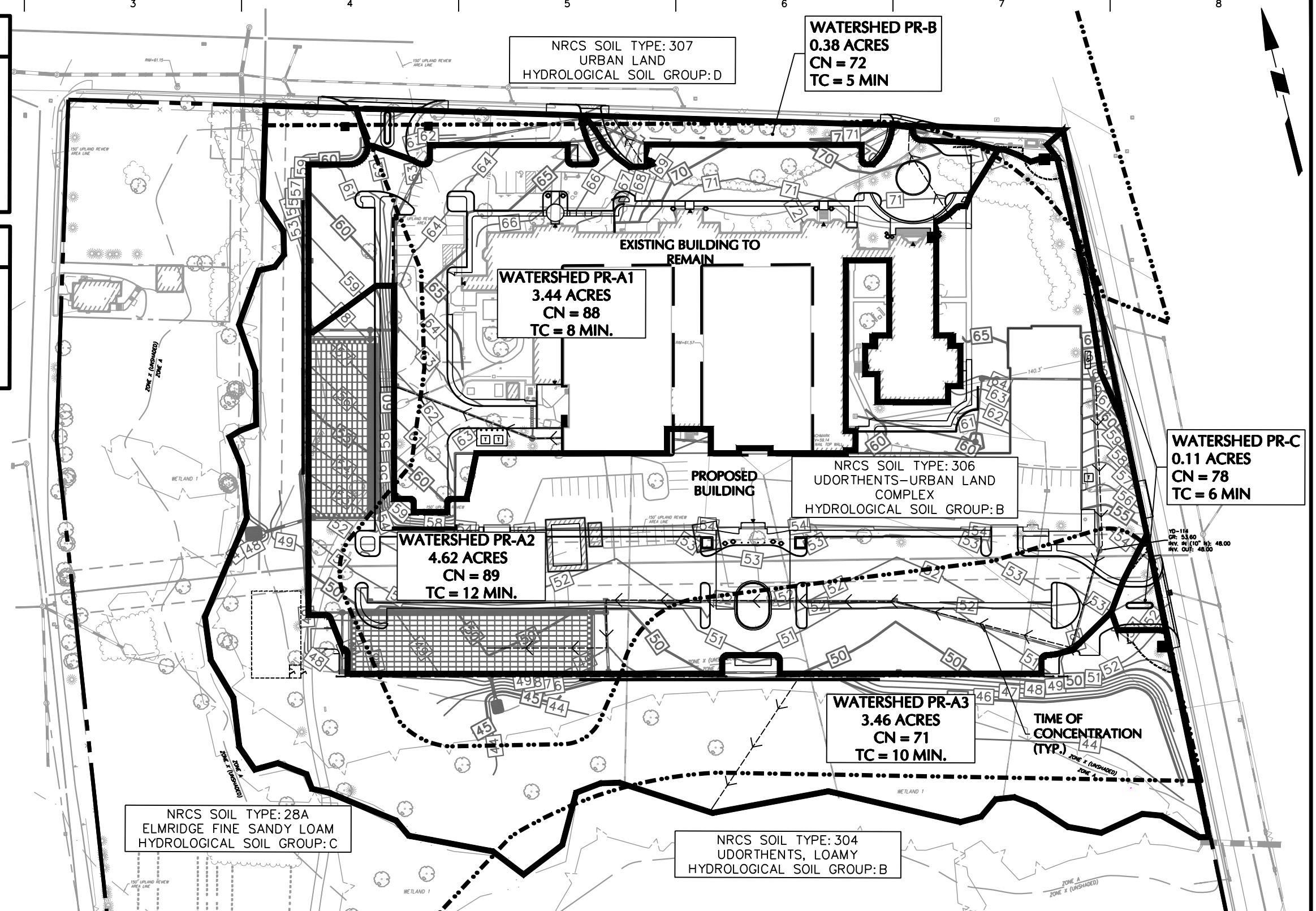
EXWS

GENERAL NOTES

- EXISTING BOUNDARY & TOPOGRAPHIC INFORMATION OBTAINED FROM A MAP TITLED "BOUNDARY & TOPOGRAPHIC SURVEY" PREPARED BY LANGAN ENGINEERING & ENVIRONMENTAL SERVICES, DATED OCTOBER 26, 2018.
- THE SITE CONTAINS AREAS WITHIN ZONE "A" FLOODPLAIN PER FIRM MAP #09003C0364F, EFFECTIVE SEPTEMBER 26, 2008.

LEGEND

- WATERSHED BOUNDARY
 TIME OF CONCENTRATION
 SOIL BOUNDARY



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100
 0
 50
 100
 SCALE IN FEET

Project

ONE PARK

WEST HARTFORD CONNECTICUT

Drawing Title

PROPOSED DRAINAGE AREA PLAN

Project No.	140184201
Date	12/06/2018
Scale	1"=100'
Drawn By	IV
Checked By	NLK

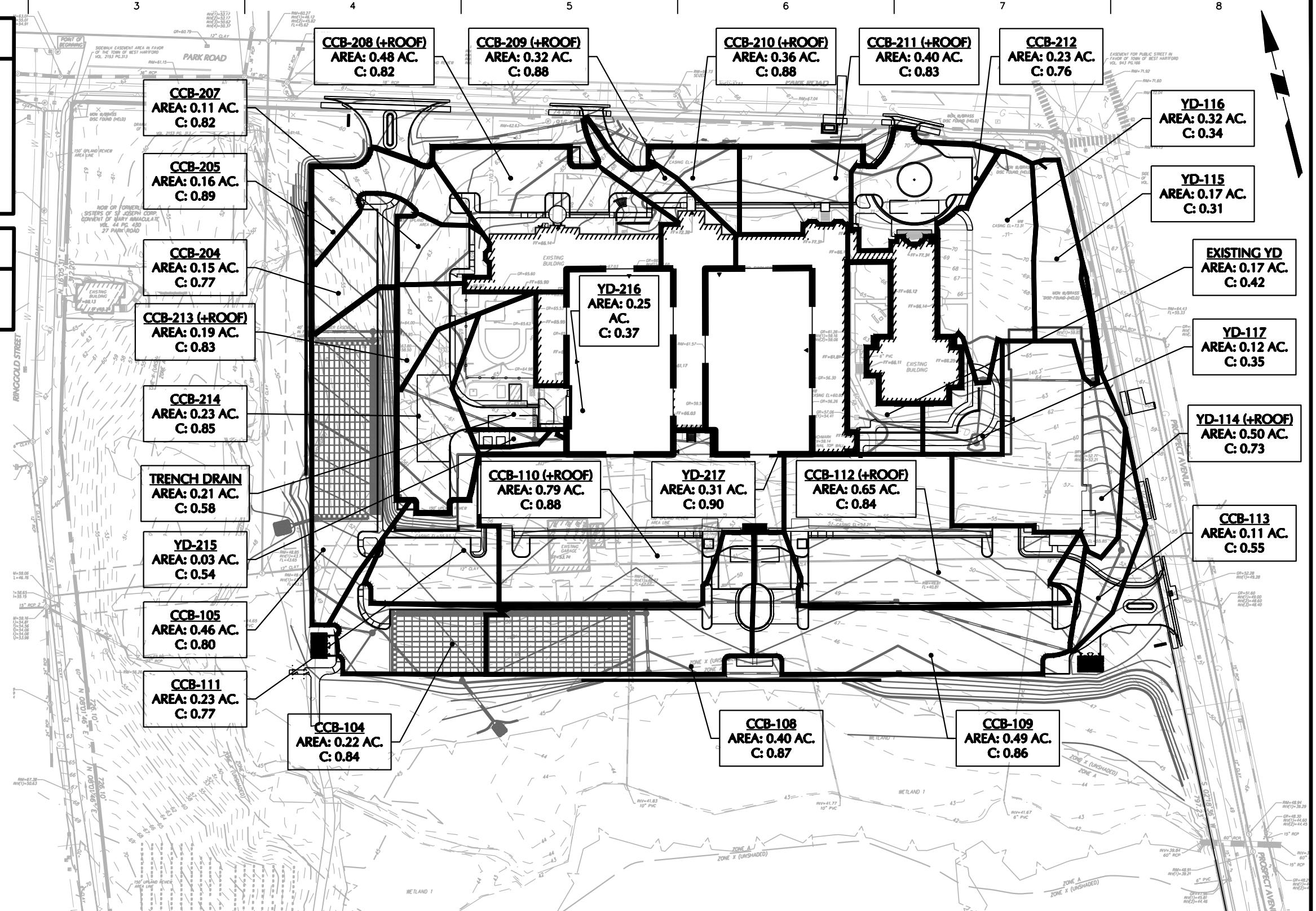
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GENERAL NOTES

- EXISTING BOUNDARY & TOPOGRAPHIC INFORMATION OBTAINED FROM A MAP TITLED "BOUNDARY & TOPOGRAPHIC SURVEY" PREPARED BY LANGAN ENGINEERING & ENVIRONMENTAL SERVICES, DATED AUGUST XX, 2018.
- THE SITE CONTAINS AREAS WITHIN ZONE "A" FLOODPLAIN PER FIRM MAP #09003C0364F, EFFECTIVE SEPTEMBER 26, 2008.

LEGEND

CATCHMENT AREAS

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0 50 100
SCALE IN FEET

Project

ONE PARK

WEST HARTFORD

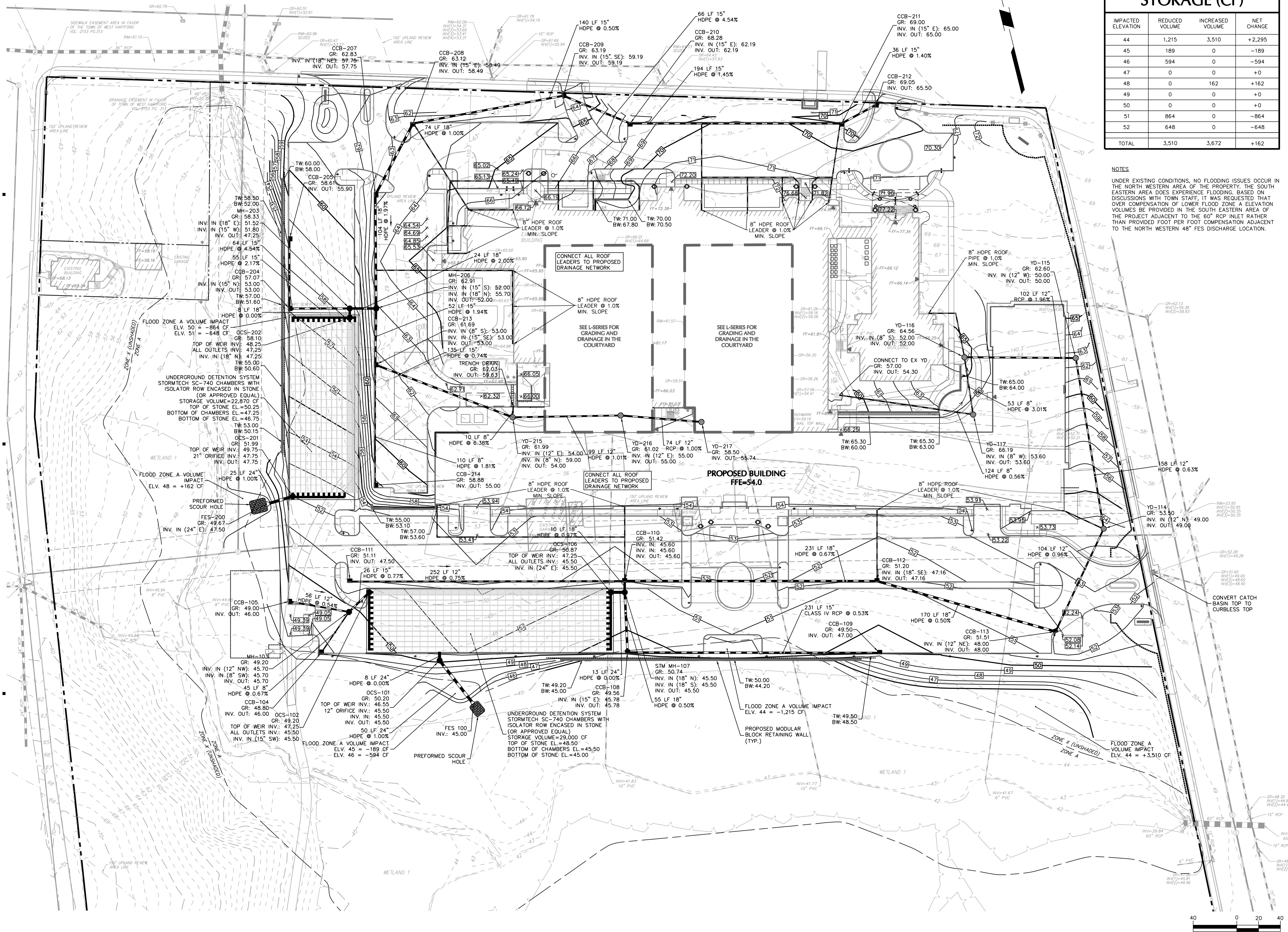
Drawing Title

CATCHMENT
AREA MAP

CONNECTICUT

Project No.
140184201
Date
12/06/2018
Scale
1"=100'
Drawn By IV
Checked By NLK

Drawing No.
DACB



APPENDIX A
Existing Stormwater Discharge Calculations

Project **ONE PARK ROAD**

By IV

Date **12/6/2018**

Location 1 PARK ROAD WEST HARTFORD, CT

Checked **NLK**

Date **12/6/2018**

Circle one: Present Developed

EX-A

1. Runoff Curve Number (CN)

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{786.85}{10.43} = 75.44 \quad \text{Use CN} = \boxed{75}$$

2. Runoff

Frequency

	Storm 1	Storm 2	Storm 3
yr			
in			
in			

Rainfall, P (24-hour)

Y

S

Runoff, Q

in

(Use P and CN with Table 2-1, Fig. 2-1,

Project ONE PARK ROAD
 Location 1 PARK ROAD WEST HARTFORD, CT
 Circle one: Present Developed

By IV Date 12/6/2018
 Checked NLK Date 12/6/2018
EX-B

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN ¹			Area 	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
B	Impervious	98			0.52	50.96
B	Open Space, Good Cond.	61			0.73	44.53
C	Open Space, Good Cond.	74			0.03	2.22
D	Open Space, Fair Cond.	84			0.15	12.60

¹ Use only one CN source per line

Totals = **1.43** **110.31**

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{110.31}{1.43} = 77.14 \quad \text{Use CN} = \boxed{77}$$

2. Runoff

	Storm 1	Storm 2	Storm 3
Frequency			
Rainfall, P (24-hour)			
S			
Runoff, Q			

(Use P and CN with Table 2-1, Fig. 2-1,

Project ONE PARK ROADBy IVDate 12/6/2018Location 1 PARK ROAD WEST HARTFORD, CTChecked NLKDate 12/6/2018Circle one: Present DevelopedEX-C1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN ¹			Area 	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
B	Impervious	98			0.02	1.96
B	Open Space, Good Cond.	61			0.10	6.10
D	Open Space, Good Cond.	80			0.03	2.40

1 Use only one CN source per line

Totals =

0.15 **10.46**

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{10.46}{0.15} = 69.73 \quad \text{Use CN} = \boxed{\textbf{70}}$$

2. Runoff

	Storm 1	Storm 2	Storm 3
Frequency			
Rainfall, P (24-hour)			
S			
Runoff, Q			

(Use P and CN with Table 2-1, Fig. 2-1,

Project One Park By BP Date 8/6/2018

Location West Hartford, CT Checked NLK Date 8/6/2018

Circle One: Present Developed

Circle One: T_c T_t through subarea Existing Drainage Area A

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)

1. Surface description (table 3-1)
2. Manning's roughness coeff., n (table 3-1)
3. Flow Length, L (total L ≤ 300 ft)
4. Two-yr 24-hr rainfall, P₂
5. Land slope, s
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$

Segment ID	AB	BC	
Short Grass Prairie	Short Grass Prairie		
0.15	0.15		
ft	50	100	
in	3.3	3.3	
ft/ft	0.020	0.050	
hr	0.092	0.111	= 0.204

Shallow concentrated flow

7. Surface description (paved or unpaved)
8. Flow length, L
9. Watercourse slope, s
10. Average velocity, V (figure 3-1)
11. $T_t = \frac{L}{3600 V}$

Segment ID	CD	
Unpaved		
ft	130	
ft/ft	0.050	
ft/s	3.6	
hr	0.010	= 0.010

Channel flow

12. Cross sectional flow area, a
13. Wetted perimeter, p_w
14. Hydraulic radius, r $r = \frac{a}{p_w}$ Compute r
15. Channel slope, s
16. Manning's roughness coeff., n
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V
18. Flow length, L
19. $T_t = \frac{L}{3600 V}$ Compute T_t
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)

Segment ID	DE	
ft ²		
ft		
ft/ft	0.020	
ft/s	5.00	
ft	200	
hr	0.011	= 0.011
		hr 0.225

Use T_c = 13 min

Project **One Park** By **BP** Date **8/6/2018**

Location **West Hartford, CT** **Checked** **NLK** **Date** **8/6/2018**

Circle One: Present Developed

Circle One: T_c T_t through subarea

Existing Drainage Area C

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)

1. Surface description (table 3-1)

2. Manning's roughness coeff., n (table 3-1)

3. Flow Length, L (total L \leq 300 ft)

4. Two-yr 24-hr rainfall, P_2

5. Land slope, s

$$6. \quad T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} S^{0.4}}$$

Segment ID	AB		
Short Grass Prairie			
0.15			
ft			
100			
in			
3.3			
ft/ft			
0.083			
Compute T_t	0.091	+	
hr			+
			=
			0.091

Shallow concentrated flow

7. Surface description (paved or unpaved)

8. Flow length, L

9. Watercourse slope, s

10. Average velocity, v (figure 3-1)

$$11. \quad T_t = \frac{L}{3600 V}$$

d)	Segment ID		
	ft		
	ft/ft		
	ft/s		
Compute T_t	hr	+	0.000

Channel flow

12. Cross sectional flow area, a

13. Wetted perimeter, p_w

$$14. \text{ Hydraulic radius, } r = \frac{a}{P_w}$$

15. Channel slope, s

16. Manning's roughness coeff., n

$$17. \quad V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

18. Flow length, L

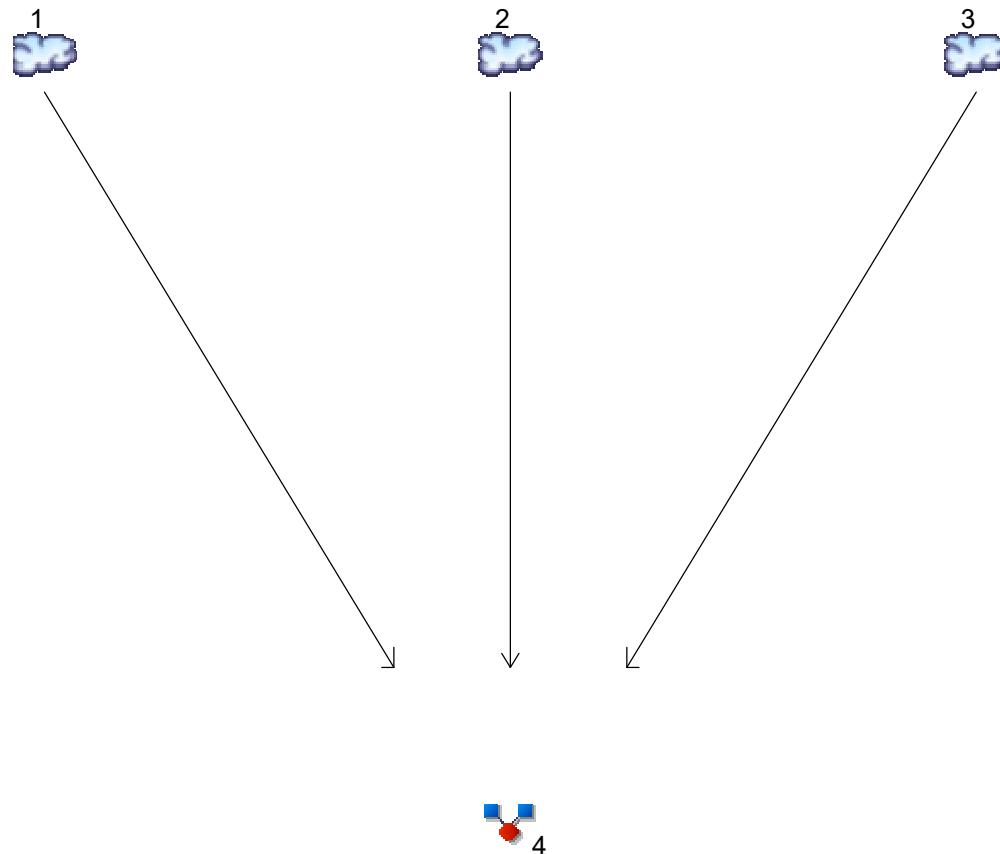
$$19. \quad T_t = \frac{L}{3600 V}$$

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)

Use Tc= 5 min

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

<u>Hyd. Origin</u>	<u>Description</u>
--------------------	--------------------

1	SCS Runoff	Watershed A
2	SCS Runoff	Watershed B
3	SCS Runoff	Watershed C
4	Combine	Total Off-site

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

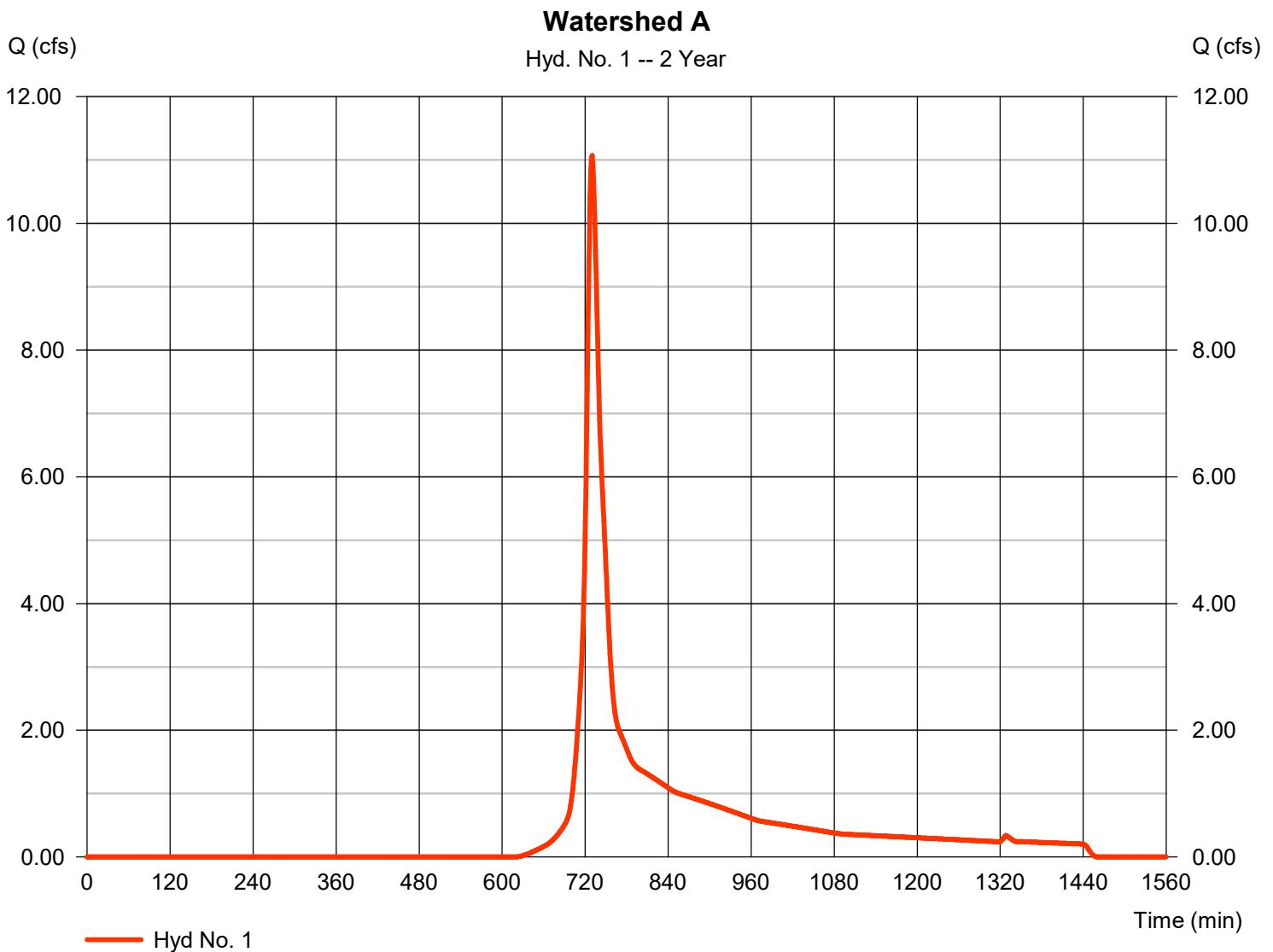
Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	----	-----	11.07	-----	-----	26.67	37.15	-----	53.82	Watershed A
2	SCS Runoff	----	-----	1.901	-----	-----	4.362	5.983	-----	8.541	Watershed B
3	SCS Runoff	----	-----	0.147	-----	-----	0.408	0.590	-----	0.885	Watershed C
4	Combine	1, 2, 3	-----	12.99	-----	-----	31.13	43.26	-----	62.66	Total Off-site

Hydrograph Report

Hyd. No. 1

Watershed A

Hydrograph type	= SCS Runoff	Peak discharge	= 11.07 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 43,314 cuft
Drainage area	= 10.430 ac	Curve number	= 75
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.00 min
Total precip.	= 3.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

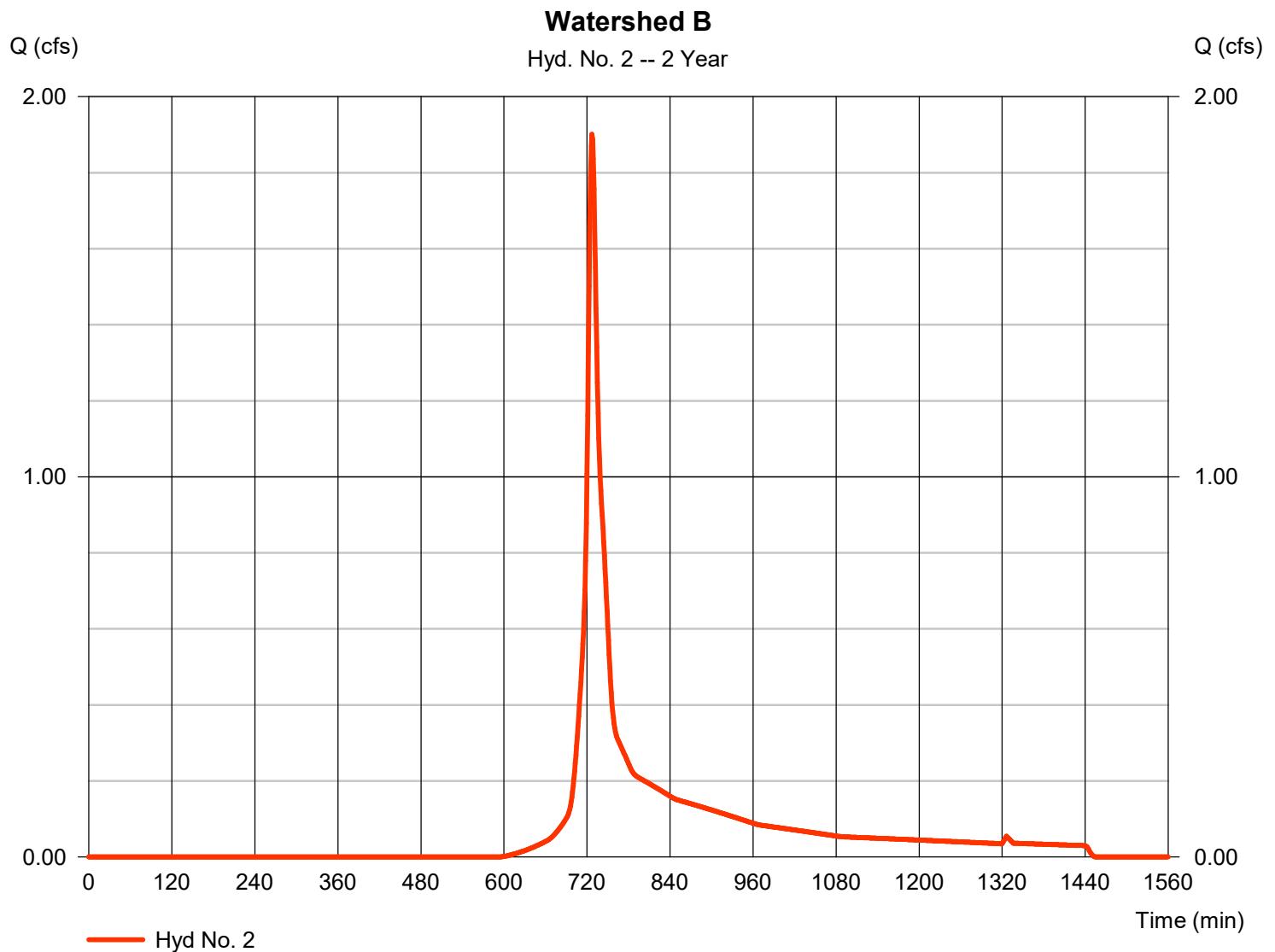
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 12 / 6 / 2018

Hyd. No. 2

Watershed B

Hydrograph type	= SCS Runoff	Peak discharge	= 1.901 cfs
Storm frequency	= 2 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 6,664 cuft
Drainage area	= 1.430 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.00 min
Total precip.	= 3.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

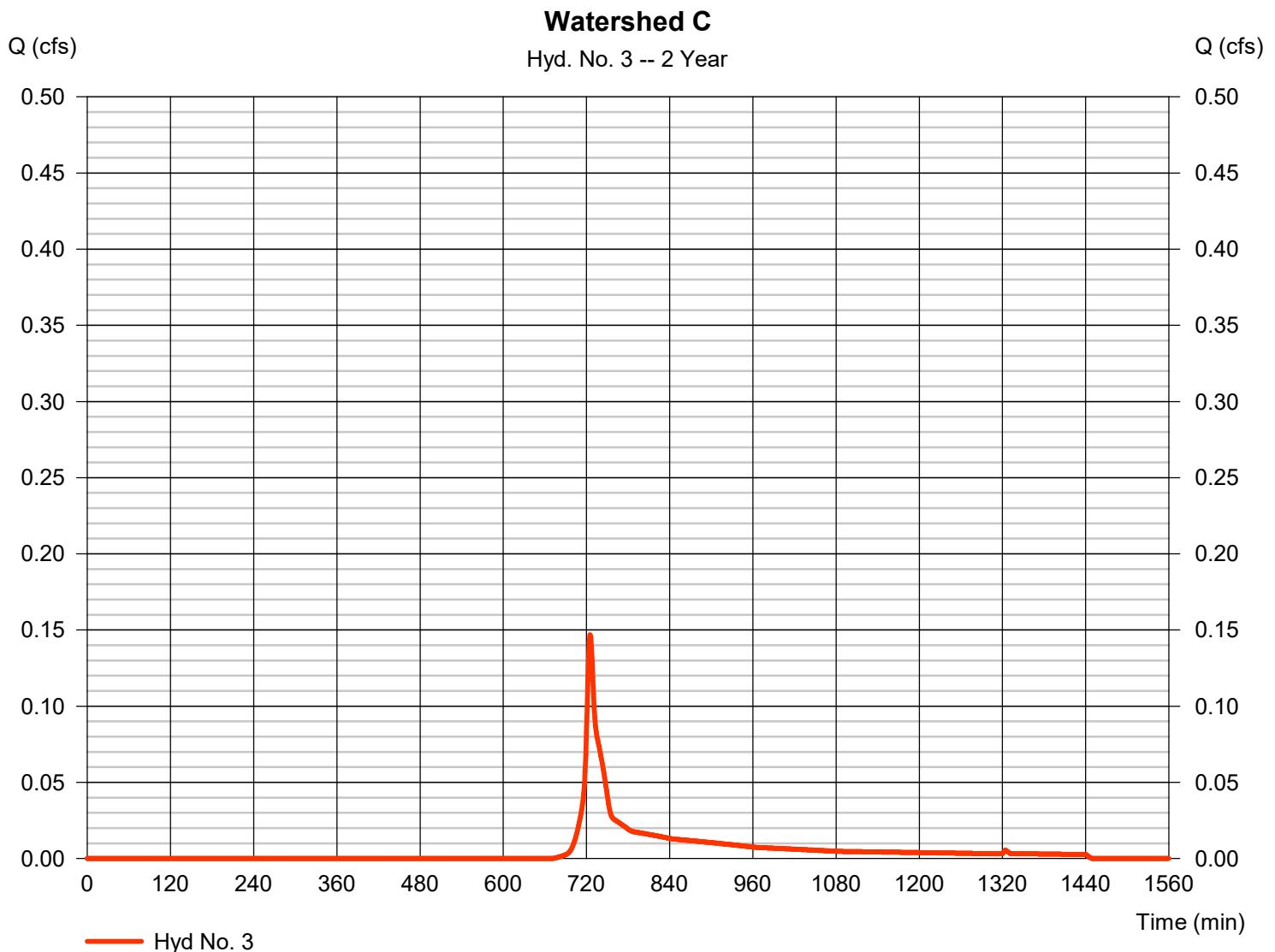


Hydrograph Report

Hyd. No. 3

Watershed C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.147 cfs
Storm frequency	= 2 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 498 cuft
Drainage area	= 0.150 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

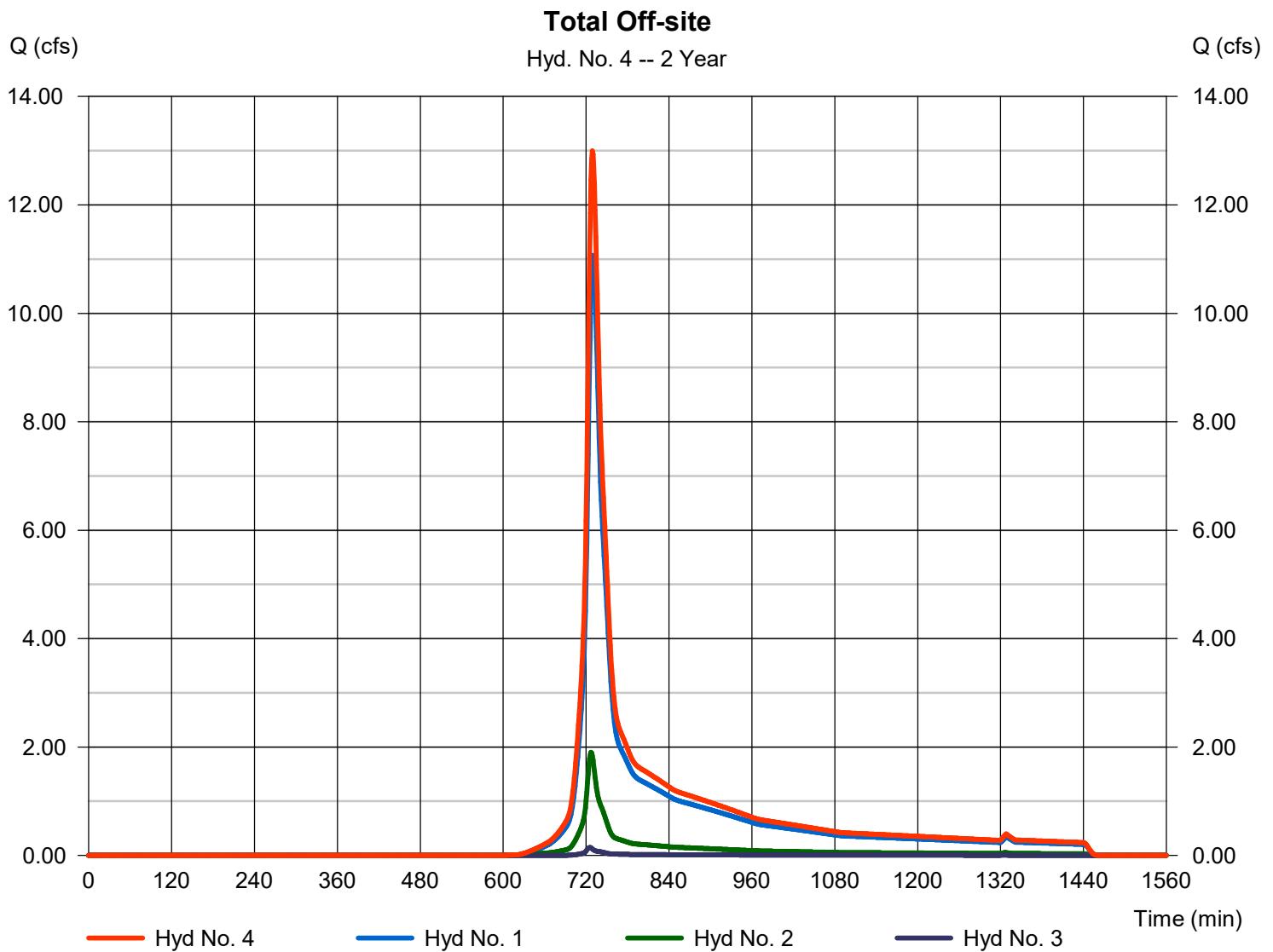
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Thursday, 12 / 6 / 2018

Hyd. No. 4

Total Off-site

Hydrograph type	= Combine	Peak discharge	= 12.99 cfs
Storm frequency	= 2 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 50,476 cuft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 12.010 ac



Hydrograph Report

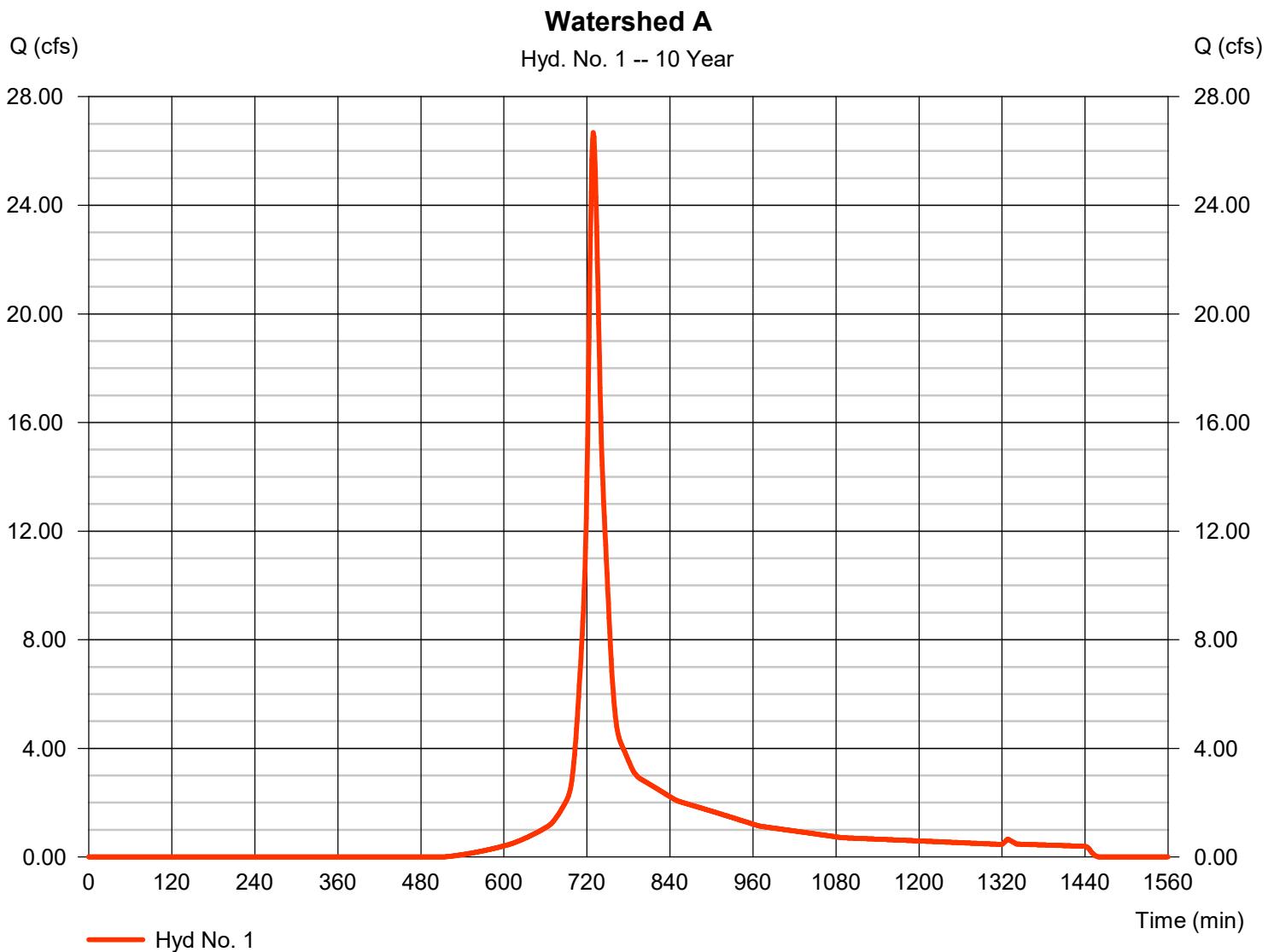
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 12 / 6 / 2018

Hyd. No. 1

Watershed A

Hydrograph type	= SCS Runoff	Peak discharge	= 26.67 cfs
Storm frequency	= 10 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 100,430 cuft
Drainage area	= 10.430 ac	Curve number	= 75
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

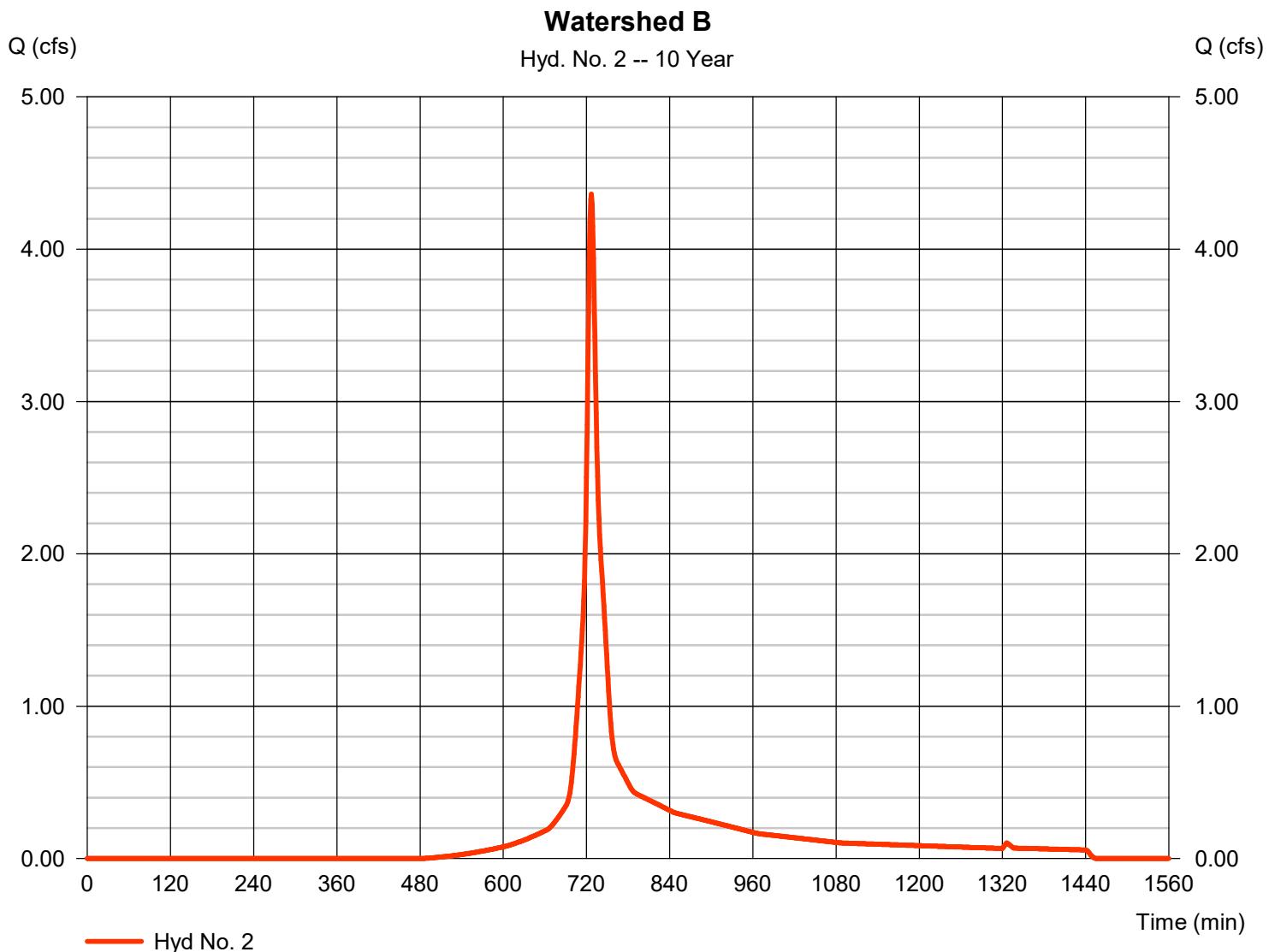
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 12 / 6 / 2018

Hyd. No. 2

Watershed B

Hydrograph type	= SCS Runoff	Peak discharge	= 4.362 cfs
Storm frequency	= 10 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 14,928 cuft
Drainage area	= 1.430 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

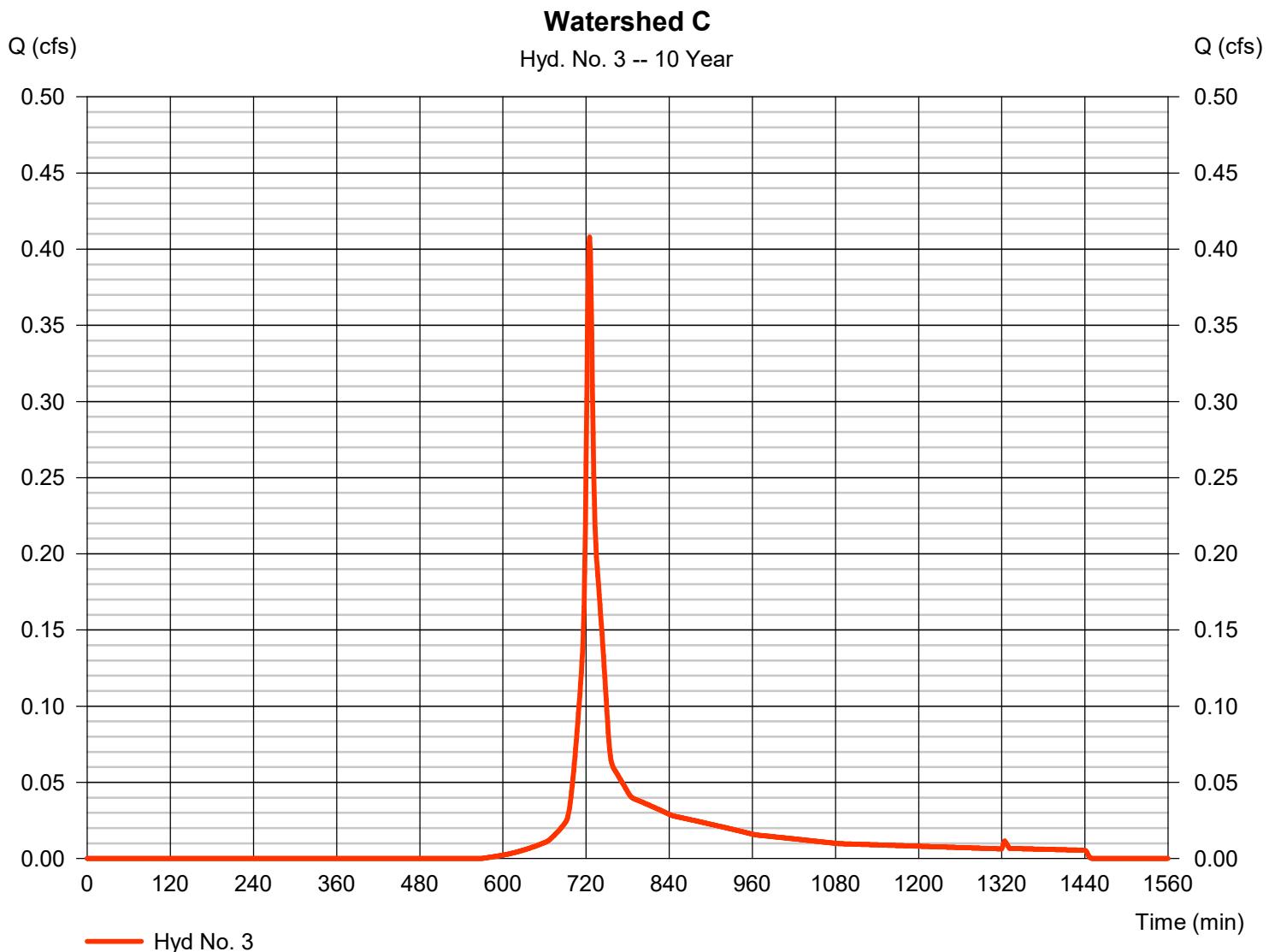
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Thursday, 12 / 6 / 2018

Hyd. No. 3

Watershed C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.408 cfs
Storm frequency	= 10 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 1,270 cuft
Drainage area	= 0.150 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

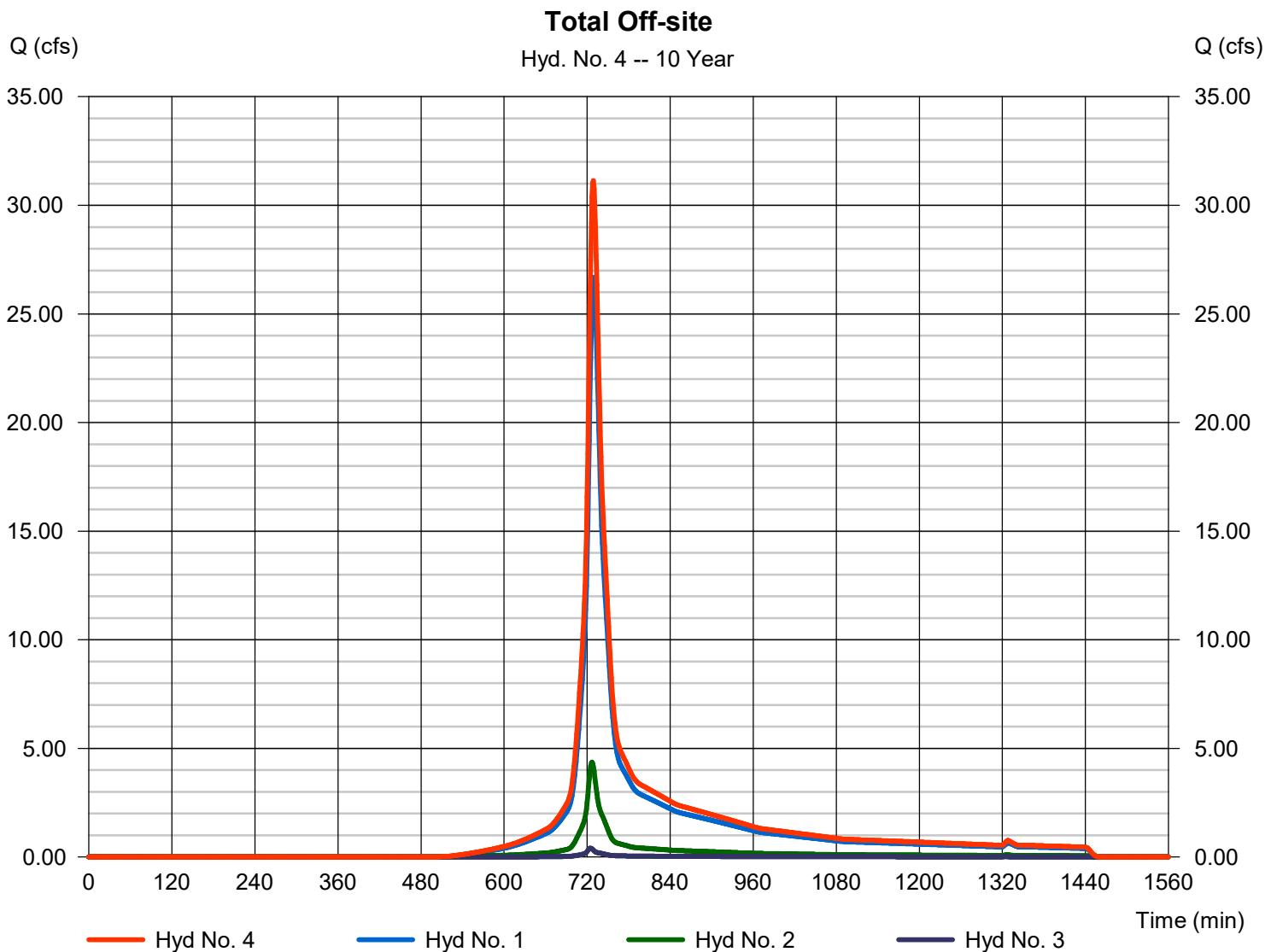
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Thursday, 12 / 6 / 2018

Hyd. No. 4

Total Off-site

Hydrograph type	= Combine	Peak discharge	= 31.13 cfs
Storm frequency	= 10 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 116,628 cuft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 12.010 ac



Hydrograph Report

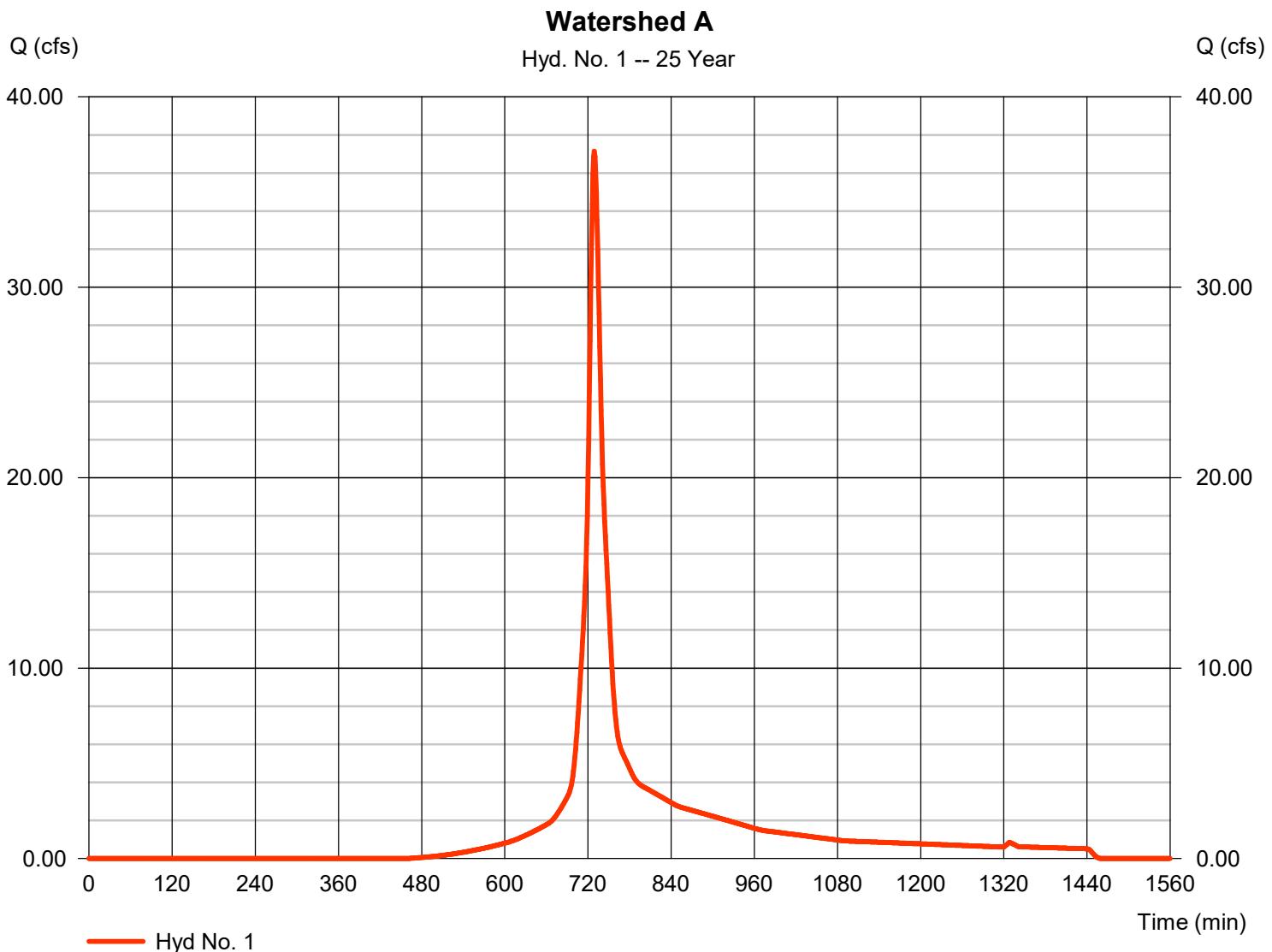
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Thursday, 12 / 6 / 2018

Hyd. No. 1

Watershed A

Hydrograph type	= SCS Runoff	Peak discharge	= 37.15 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 139,643 cuft
Drainage area	= 10.430 ac	Curve number	= 75
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.00 min
Total precip.	= 6.54 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

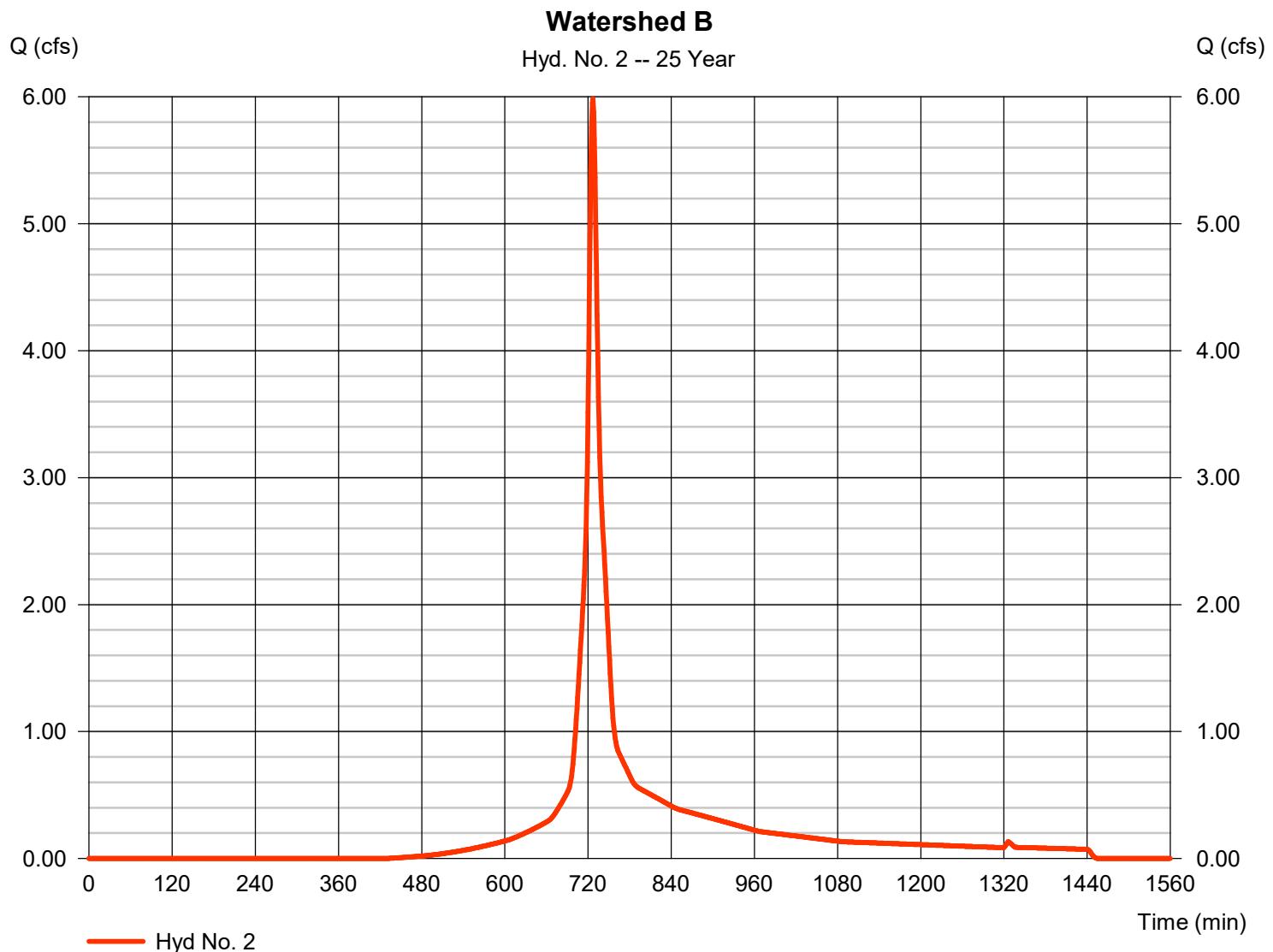
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Thursday, 12 / 6 / 2018

Hyd. No. 2

Watershed B

Hydrograph type	= SCS Runoff	Peak discharge	= 5.983 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 20,529 cuft
Drainage area	= 1.430 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.00 min
Total precip.	= 6.54 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

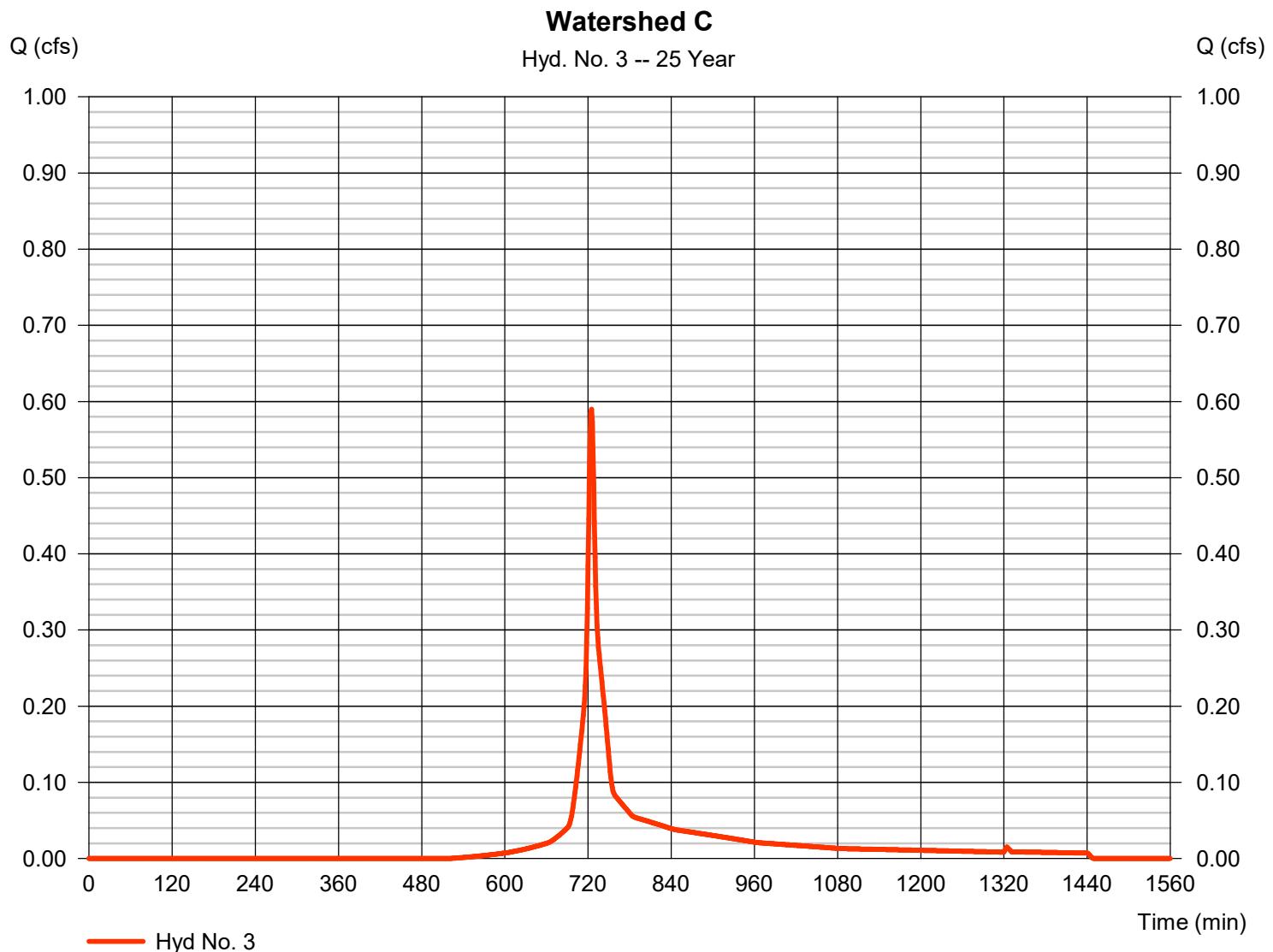
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 12 / 6 / 2018

Hyd. No. 3

Watershed C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.590 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 1,819 cuft
Drainage area	= 0.150 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.54 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

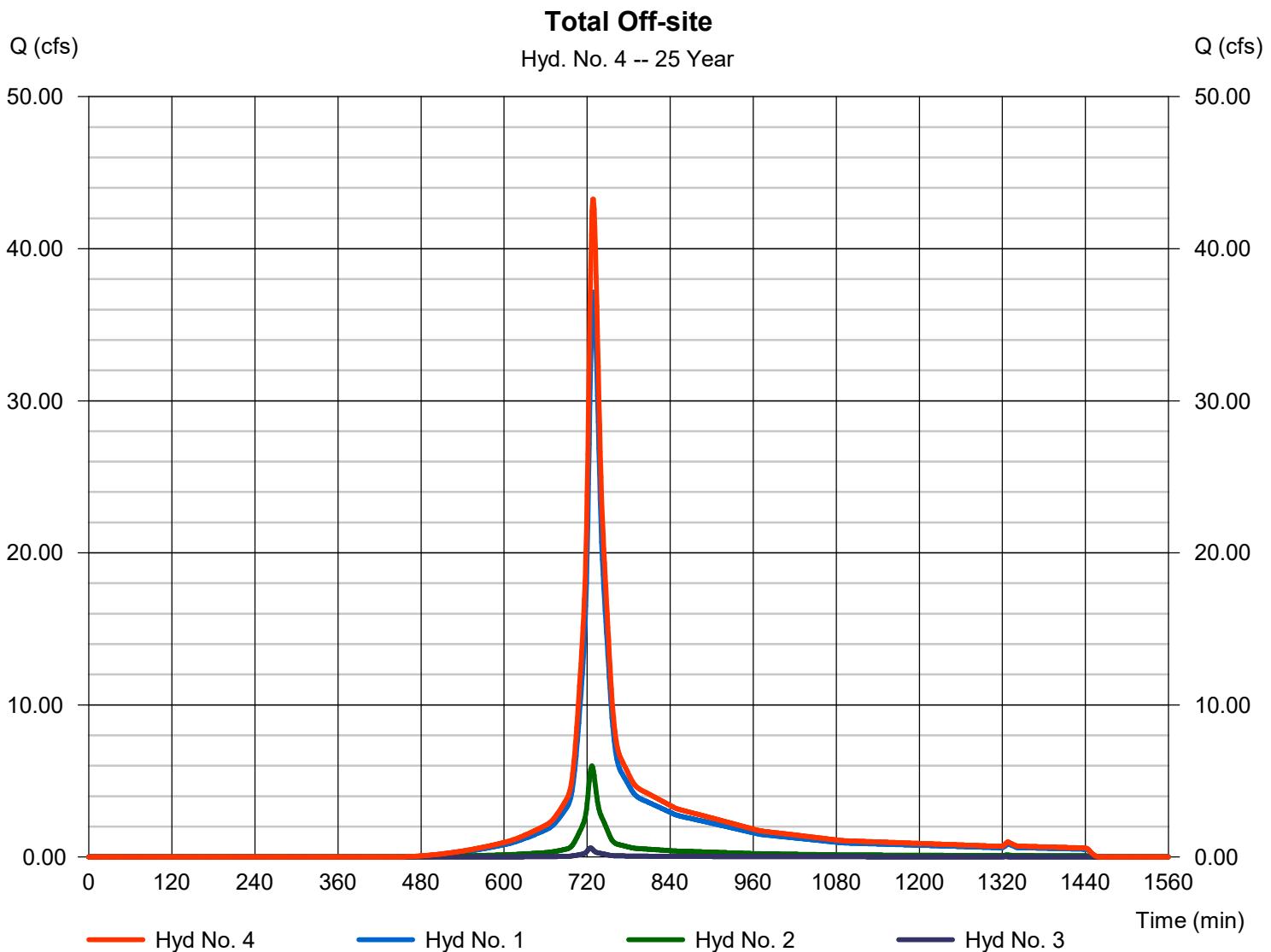
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Thursday, 12 / 6 / 2018

Hyd. No. 4

Total Off-site

Hydrograph type	= Combine	Peak discharge	= 43.26 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 161,991 cuft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 12.010 ac



Hydrograph Report

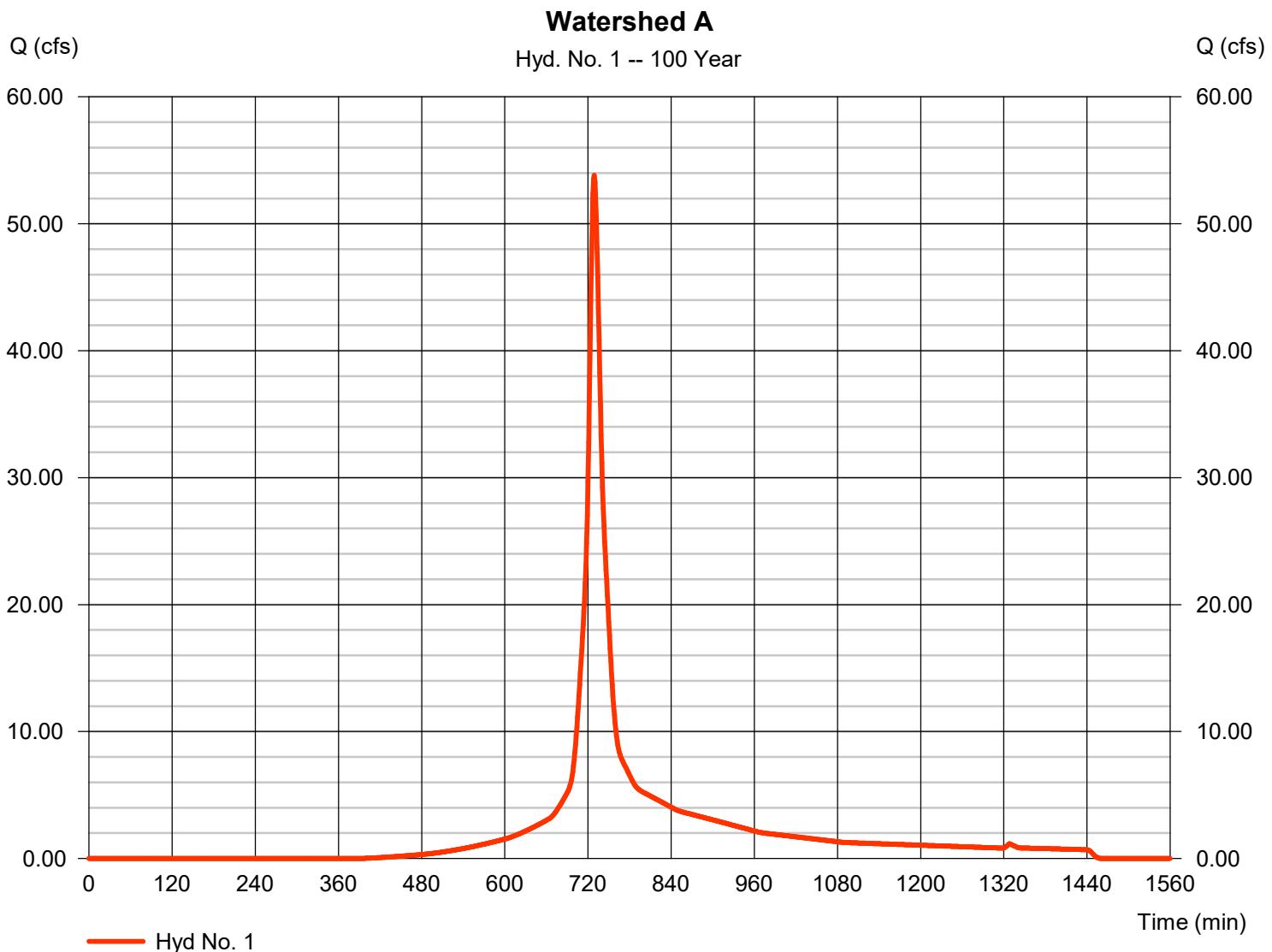
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Thursday, 12 / 6 / 2018

Hyd. No. 1

Watershed A

Hydrograph type	= SCS Runoff	Peak discharge	= 53.82 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 203,438 cuft
Drainage area	= 10.430 ac	Curve number	= 75
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.00 min
Total precip.	= 8.46 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

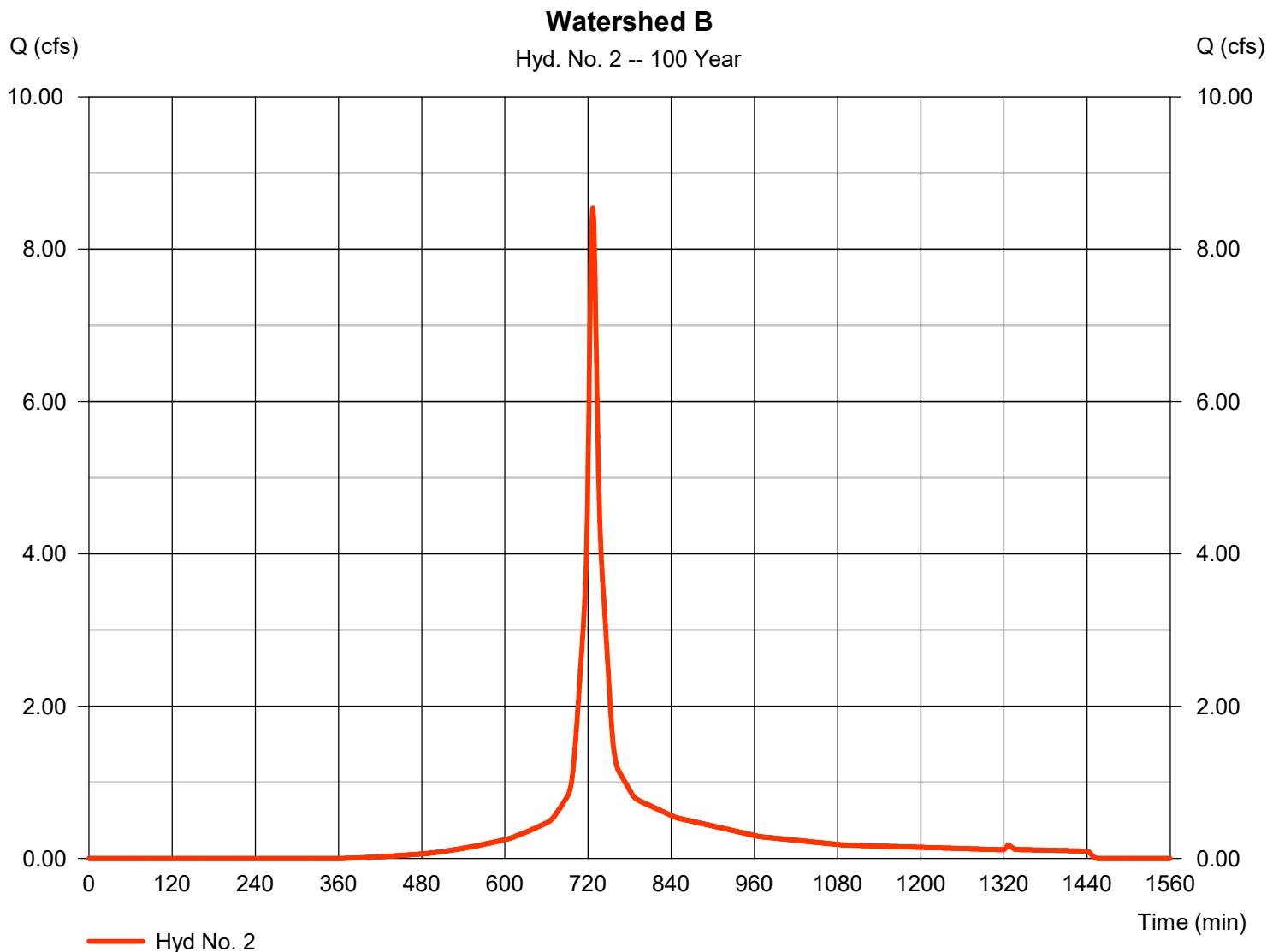
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Thursday, 12 / 6 / 2018

Hyd. No. 2

Watershed B

Hydrograph type	= SCS Runoff	Peak discharge	= 8.541 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 29,577 cuft
Drainage area	= 1.430 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.00 min
Total precip.	= 8.46 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

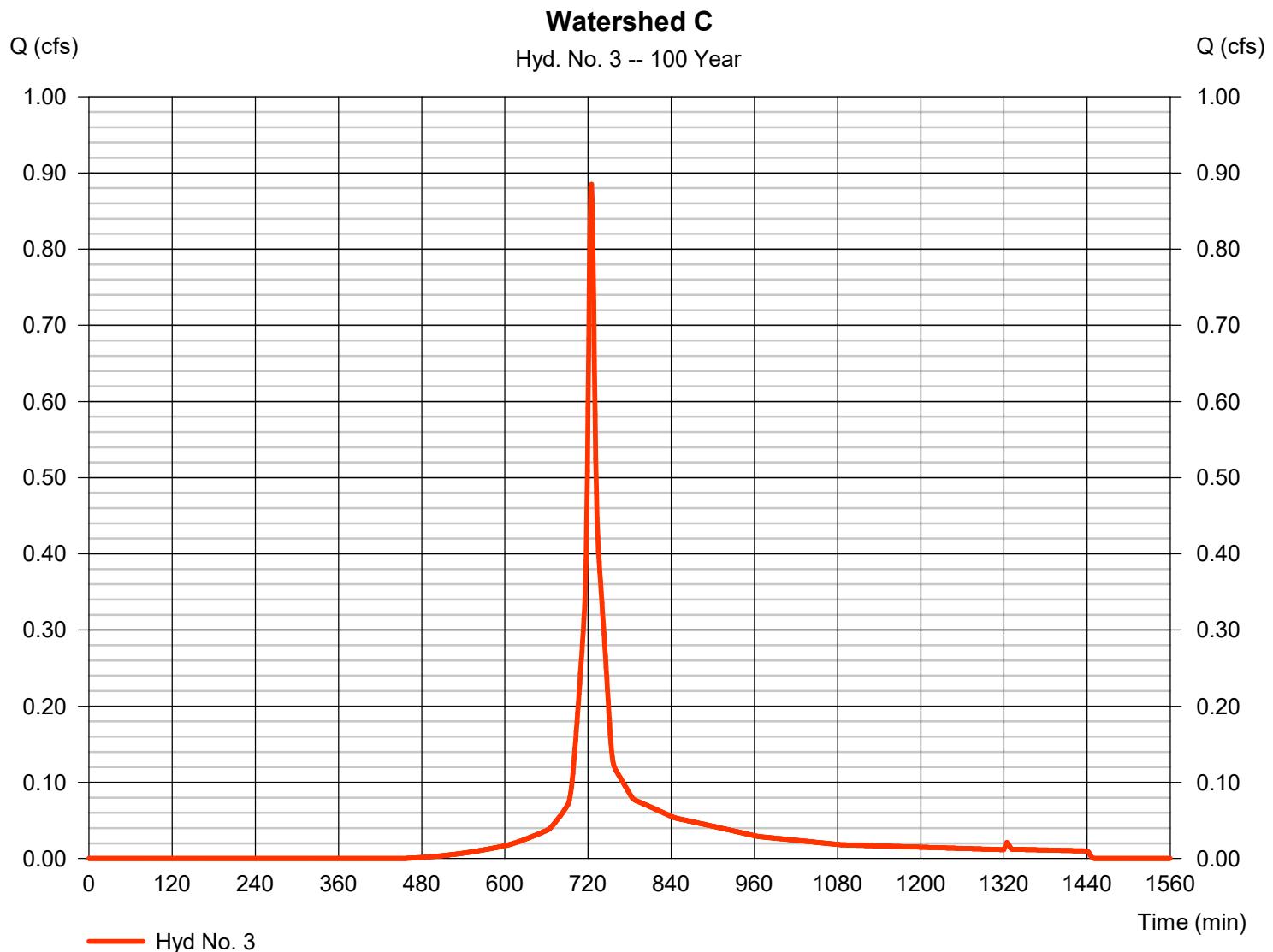
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 12 / 6 / 2018

Hyd. No. 3

Watershed C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.885 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 2,730 cuft
Drainage area	= 0.150 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 8.46 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

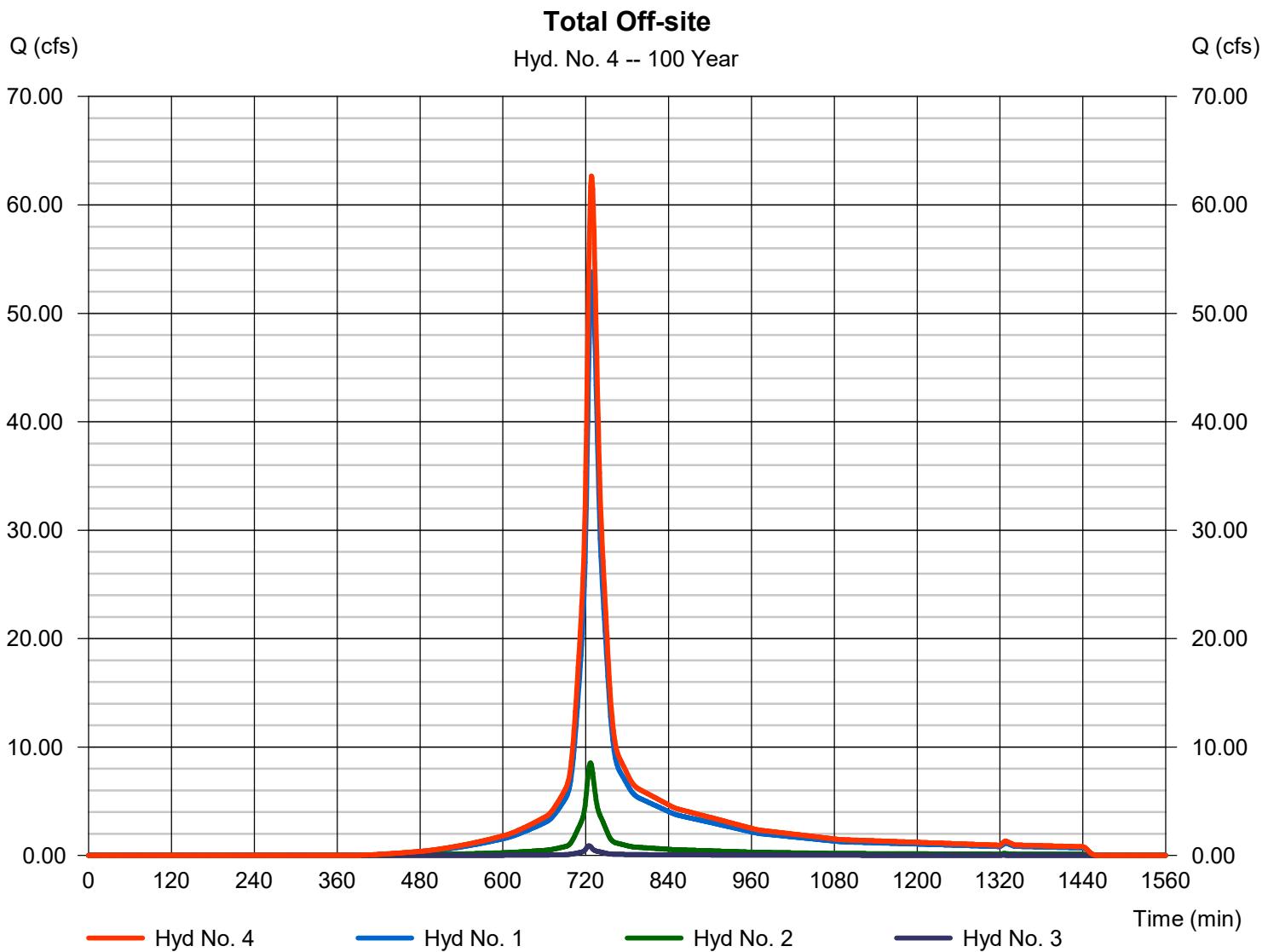
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 12 / 6 / 2018

Hyd. No. 4

Total Off-site

Hydrograph type	= Combine	Peak discharge	= 62.66 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 235,746 cuft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 12.010 ac



APPENDIX B

Proposed Stormwater Discharge Calculations

Project ONE PARK ROAD
 Location 1 PARK ROAD WEST HARTFORD, CT
 Circle one: Present Developed

By RJS Date 12/6/2018
 Checked NLK Date 12/6/2018
PR-A1

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN ¹			Area 	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
C	Impervious	98			0.36	34.99
C	Open Space, Good Cond.	74			0.03	2.18
B	Impervious	98			2.11	206.61
B	Open Space, Good Cond.	61			0.94	57.06
1 Use only one CN source per line		Totals =			3.43	300.83

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{300.83}{3.43} = 87.70 \quad \text{Use CN} = \boxed{\mathbf{88}}$$

2. Runoff

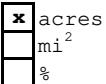
	Storm 1	Storm 2	Storm 3
Frequency			
Rainfall, P (24-hour)			
S			
Runoff, Q			

(Use P and CN with Table 2-1, Fig. 2-1,

Project ONE PARK ROAD
 Location 1 PARK ROAD WEST HARTFORD, CT
 Circle one: Present Developed

By RJS Date 12/6/2018
 Checked NLK Date 12/6/2018
PR-A2

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN ¹			Area 	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
B	Impervious	98			2.23	218.92
B	Open Space, Good Cond.	61			1.01	61.85
C	Impervious	98			1.16	114.07
C	Open Space, Good Cond.	74			0.17	12.82
D	Open Space, Good Cond.	80			0.03	2.41
1 Use only one CN source per line		Totals =			4.62	410.08

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{410.08}{4.62} = 88.85 \quad \text{Use CN} = \boxed{\mathbf{89}}$$

2. Runoff

	Storm 1	Storm 2	Storm 3
Frequency			
Rainfall, P (24-hour)			
S			
Runoff, Q			

(Use P and CN with Table 2-1, Fig. 2-1,

Project **ONE PARK ROAD**
Location **1 PARK ROAD WEST HARTFORD, CT**
Circle one: Present Developed

By RJS Date 12/6/2018
Checked NLK Date 12/6/2018

PR-A3

1. Runoff Curve Number (CN)

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{254.42}{3.57} = 71.27 \quad \text{Use CN} = \boxed{71}$$

2. Runoff

Frequency
Rainfall, P (24-hour)
S
Runoff, Q

Storm 1	Storm 2	Storm 3

(Use P and CN with Table 2-1, Fig. 2-1,

Project ONE PARK ROAD
 Location 1 PARK ROAD WEST HARTFORD, CT
 Circle one: Present Developed

By RJS Date 12/6/2018
 Checked NLK Date 12/6/2018
PR-B

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN ¹			Area 	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
D	Impervious	98			0.05	5.31
D	Open Space, Good Cond.	80			0.07	5.24
B	Impervious	98			0.03	2.86
B	Open Space, Good Cond.	61			0.23	14.16

1 Use only one CN source per line

Totals =

0.38 **27.57**

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{27.57}{0.38} = 72.36 \quad \text{Use CN} = \boxed{\textbf{72}}$$

2. Runoff

	Storm 1	Storm 2	Storm 3
Frequency			
Rainfall, P (24-hour)			
S			
Runoff, Q			

(Use P and CN with Table 2-1, Fig. 2-1,

Project ONE PARK ROAD
 Location 1 PARK ROAD WEST HARTFORD, CT
 Circle one: Present Developed

By RJS Date 12/6/2018
 Checked NLK Date 12/6/2018
PR-C

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN ¹			Area 	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
C	Impervious	98			0.04	3.63
C	Open Space, Good Cond.	74			0.02	1.25
D	Impervious	98			0.01	0.76
B	Open Space, Good Cond.	61			0.05	2.99

¹ Use only one CN source per line

Totals =	0.11	8.63
----------	-------------	-------------

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{8.63}{0.11} = 77.96 \quad \text{Use CN} = \boxed{\bmod{78}}$$

2. Runoff

	Storm 1	Storm 2	Storm 3
Frequency			
Rainfall, P (24-hour)			
S			
Runoff, Q			

(Use P and CN with Table 2-1, Fig. 2-1,

Project One Park By IV Date 10/23/2018

Location West Hartford, CT Checked NLK Date 10/23/2018

Circle One: Present Developed

Circle One: T_c T_t through subarea

Proposed Drainage Area A1

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)

1. Surface description (table 3-1)
2. Manning's roughness coeff., n (table 3-1)
3. Flow Length, L (total L ≤ 300 ft)
4. Two-yr 24-hr rainfall, P₂
5. Land slope, s
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$

Segment ID	AB		
Short Grass Prairie			
0.15			
ft	100		
in	3.3		
ft/ft	0.050		
hr	0.111	+	
			=
			0.111

Shallow concentrated flow

7. Surface description (paved or unpaved)
8. Flow length, L
9. Watercourse slope, s
10. Average velocity, V (figure 3-1)
11. $T_t = \frac{L}{3600 V}$

Segment ID			
ft			
ft/ft			
ft/s			
hr		+	
			=
			0.000

Channel flow

12. Cross sectional flow area, a
13. Wetted perimeter, p_w
14. Hydraulic radius, r $r = \frac{a}{p_w}$ Compute r
15. Channel slope, s
16. Manning's roughness coeff., n
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V
18. Flow length, L
19. $T_t = \frac{L}{3600 V}$ Compute T_t
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)

Segment ID	BC		
ft ²			
ft			
ft/ft	0.030		
ft/s	5.00		
ft	400		
hr	0.022	+	
			=
			0.022
			0.134 hr

Use T_c= 8 min

Project **One Park** By **IV** Date **10/23/2018**

Location West Hartford, CT **Checked** NLK **Date** 10/23/2018

Circle One: Present Developed

Circle One: T_c T_t through subarea

Proposed Drainage Area A2

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T- Only)

1. Surface description (table 3-1)
 2. Manning's roughness coeff., n (table 3-1)
 3. Flow Length, L (total L ≤ 300 ft)
 4. Two-yr 24-hr rainfall, P₂
 5. Land slope, s
 6. $T_t = \frac{0.007(nL_1)^{0.8}}{P_{2,0.5}^{0.4}}$ Com

$$6. \quad T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} S^{0.4}}$$

Segment TD

AB		
Short Grass Prairie		
0.15		
150		
3.3		
0.050	#DIV/0!	
0.154	+	

0154

Shallow concentrated flow

7. Surface description (paved or unpaved)
 8. Flow length, L
 9. Watercourse slope, s
 10. Average velocity, V (figure 3-1)
 11. $T_t = \frac{L}{3600 V}$

$$11. \quad T_t = \frac{L}{3600 V}$$

Segment ID

r	<input type="text"/>	+	<input type="text"/>	=	<input type="text" value="0.000"/>

0.000

Channel flow

12. Cross sectional flow area, a
 13. Wetted perimeter, P_w
 14. Hydraulic radius, r
 15. Channel slope, s
 16. Manning's roughness coeff., n
 17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$
 18. Flow length, L
 19. $T_t = \frac{L}{3600 V}$
 20. Watershed or subarea T_c or T_r

$$17. \quad V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Segment ID

	BC	
2		
0.020		
5.00		
750		
0.042	+	
	=	0.042

0.042

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)

Use Tc= 12 min

Project **One Park** By **IV** Date **10/23/2018**

Location West Hartford, CT **Checked** NLK **Date** 10/23/2018

Circle One: Present Developed

Circle One: T_c T_t through subarea

Proposed Drainage Area A3

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)

1. Surface description (table 3-1)
 2. Manning's roughness coeff., n (table 3-1)
 3. Flow Length, L (total L ≤ 300 ft)
 4. Two-yr 24-hr rainfall, P₂
 5. Land slope, s
 6. $T_t = \frac{0.007(nL_1)^{0.8}}{P_{2,0.5}^{0.4}}$ Com

$$6. \quad T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} S^{0.4}}$$

Segment ID

AB		
Short Grass Prairie		
0.15		
130		
3.3		
0.030		
0.169	+	+

= 0.169

Shallow concentrated flow

7. Surface description (paved or unpaved)
 8. Flow length, L
 9. Watercourse slope, s
 10. Average velocity, V (figure 3-1)
 11. $T_t = \frac{L}{3600 V}$

$$11. \quad T_t = \frac{L}{3600 V}$$

Segment ID

r	
	+
	=
	0.000

0.000

Channel flow

12. Cross sectional flow area, a
 13. Wetted perimeter, p_w
 14. Hydraulic radius, r
 15. Channel slope, s
 16. Manning's roughness coeff., n
 17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$
 18. Flow length, L
 19. $T_t = \frac{L}{3600 V}$
 20. Watershed or subarea T_c or T_r

$$17. \text{ Manning's roughness coeff., } V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

$$18. \text{ Flow length, } L$$

$$19. T_t = \frac{L}{3600 v}$$

Segment ID

0.000

0.169

Use Tc= 10 min

Project One Park By IV Date 10/23/2018

Location West Hartford, CT Checked NLK Date 10/23/2018

Circle One: Present Developed

Circle One: T_c T_t through subarea

Proposed Drainage Area B

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)

1. Surface description (table 3-1)
2. Manning's roughness coeff., n (table 3-1)
3. Flow Length, L (total L ≤ 300 ft)
4. Two-yr 24-hr rainfall, P₂
5. Land slope, s
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$

Segment ID	AB	BC	
Short Grass Prairie	Short Grass Prairie		
0.15	0.15		
ft	15	36	
in	3.3	3.3	
ft/ft	0.069	0.113	
hr	0.021	0.035	= 0.056

Shallow concentrated flow

7. Surface description (paved or unpaved)
8. Flow length, L
9. Watercourse slope, s
10. Average velocity, V (figure 3-1)
11. $T_t = \frac{L}{3600 V}$

Segment ID		
ft		
ft/ft		
ft/s		
hr		= 0.000

Channel flow

12. Cross sectional flow area, a
13. Wetted perimeter, p_w
14. Hydraulic radius, r $r = \frac{a}{p_w}$ Compute r
15. Channel slope, s
16. Manning's roughness coeff., n
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V
18. Flow length, L
19. $T_t = \frac{L}{3600 V}$ Compute T_t
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)

Segment ID			
ft ²			
ft			
ft/ft			
ft/s			
hr		+ 0.000	= 0.056 hr

Use T_c= 5 min

Project One Park By IV Date 10/23/2018

Location West Hartford, CT Checked NLK Date 10/23/2018

Circle One: Present Developed

Circle One: T_c T_t through subarea

Proposed Drainage Area C

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)

1. Surface description (table 3-1)
2. Manning's roughness coeff., n (table 3-1)
3. Flow Length, L (total L ≤ 300 ft)
4. Two-yr 24-hr rainfall, P₂
5. Land slope, s
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$

Segment ID	AB		
Short Grass Prairie			
0.15			
ft	91		
in	3.3		
ft/ft	0.066		
hr	0.093	+	
			=
			0.093

Shallow concentrated flow

7. Surface description (paved or unpaved)
8. Flow length, L
9. Watercourse slope, s
10. Average velocity, V (figure 3-1)
11. $T_t = \frac{L}{3600 V}$

Segment ID			
ft			
ft/ft			
ft/s			
hr		+	
			=
			0.000

Channel flow

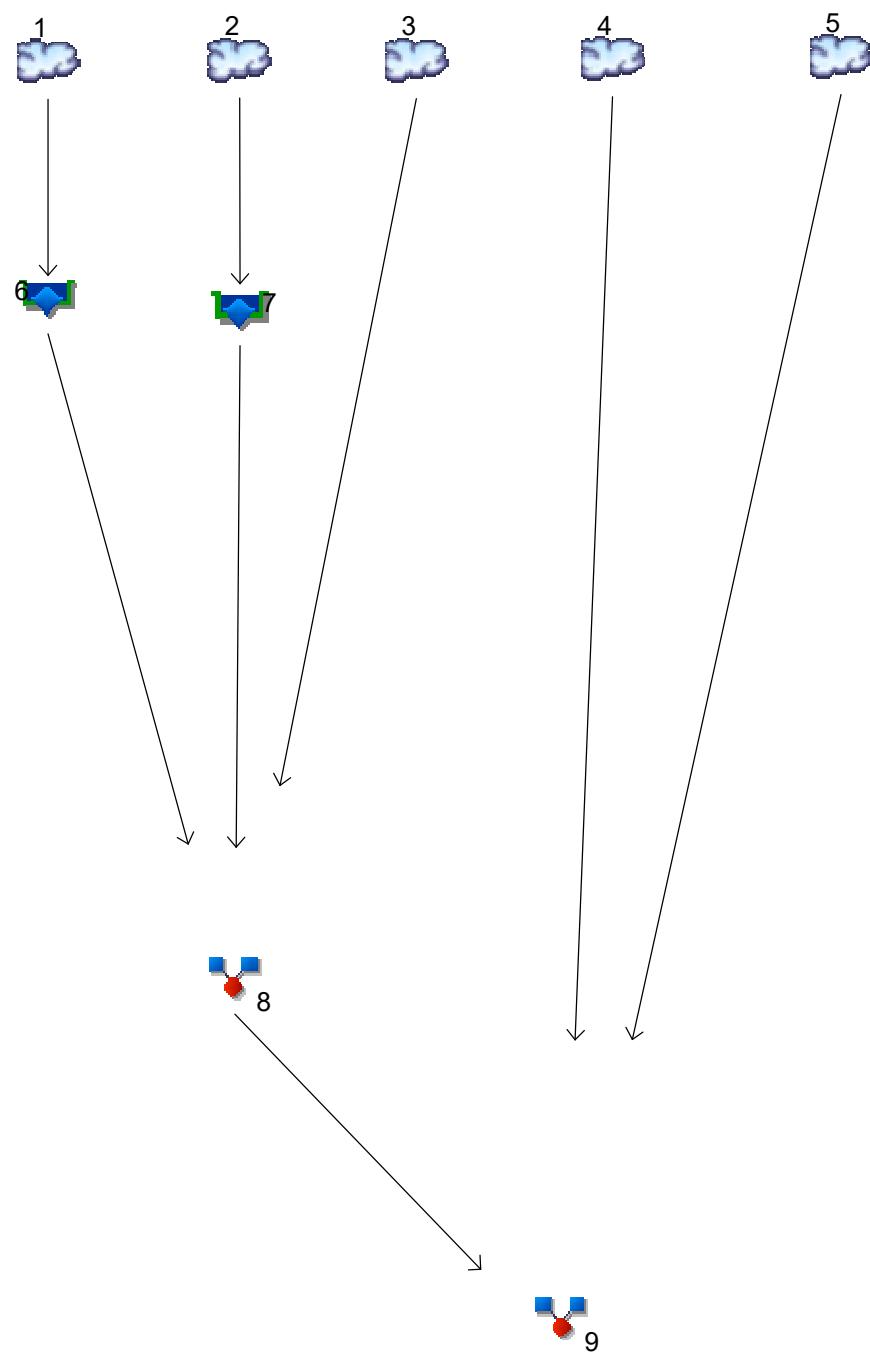
12. Cross sectional flow area, a
13. Wetted perimeter, p_w
14. Hydraulic radius, r $r = \frac{a}{p_w}$ Compute r
15. Channel slope, s
16. Manning's roughness coeff., n
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V
18. Flow length, L
19. $T_t = \frac{L}{3600 V}$ Compute T_t
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)

Segment ID			
ft ²			
ft			
ft			
ft/ft			
ft/s			
hr		+	
			=
			0.000
			0.093 hr

Use T_c= 6 min

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	7.854	1	726	25,411	----	----	----	WS PR-A1
2	SCS Runoff	9.473	1	729	35,874	----	----	----	WS PR-A2
3	SCS Runoff	3.164	1	728	11,791	----	----	----	WS PR-A3
4	SCS Runoff	0.429	1	725	1,412	----	----	----	WS PR-B
5	SCS Runoff	0.177	1	725	555	----	----	----	WS PR-C
6	Reservoir	2.464	1	745	19,064	1	48.40	11,558	DetentionA1
7	Reservoir	3.655	1	748	32,607	2	46.71	15,180	Detention A2
8	Combine	7.551	1	744	63,462	3, 6, 7	----	----	To Wetland
9	Combine	7.777	1	744	65,428	4, 5, 8	----	----	Total Site
proposed.gpw				Return Period: 2 Year				Wednesday, 12 / 26 / 2018	

Hydrograph Report

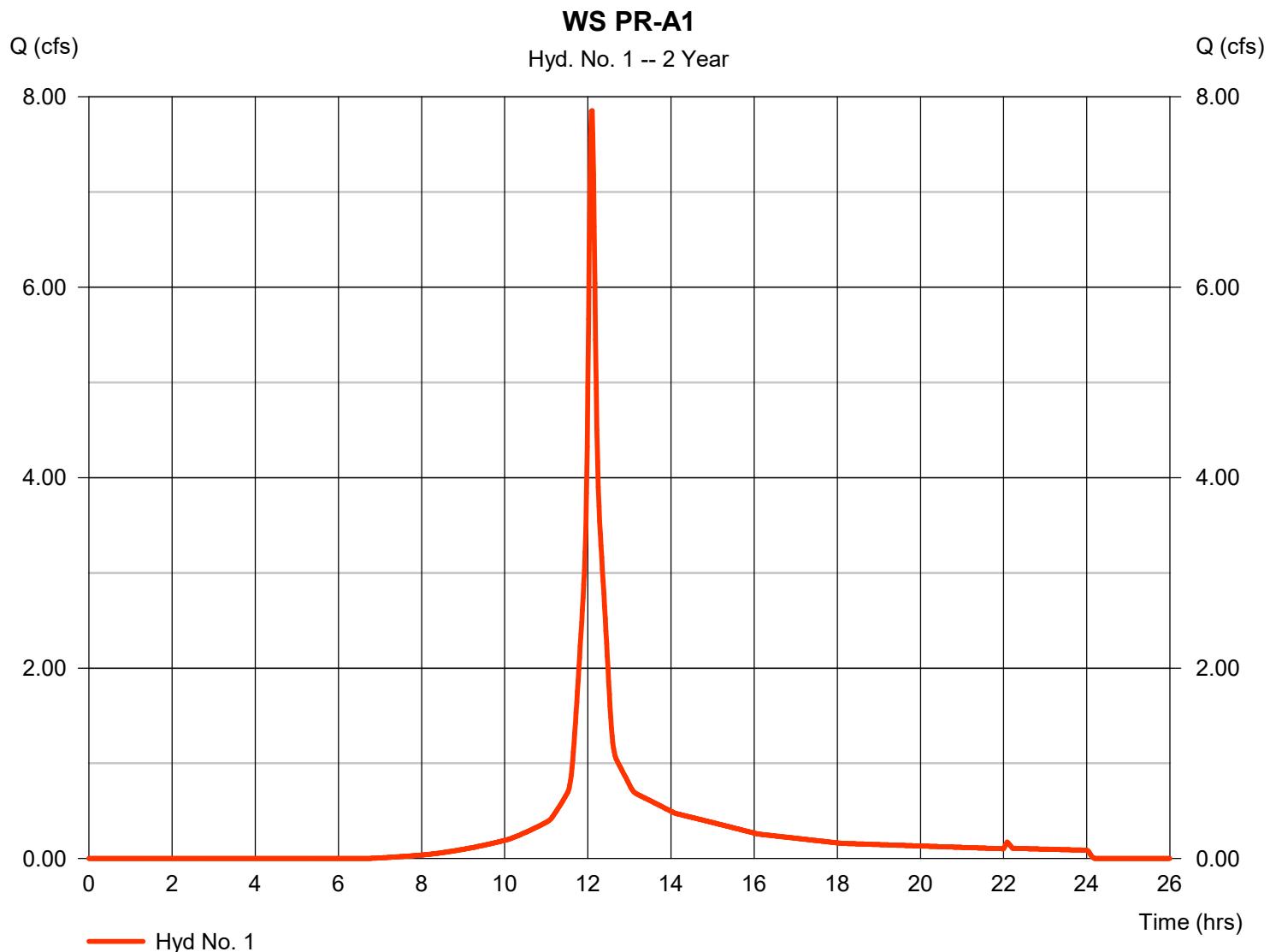
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 1

WS PR-A1

Hydrograph type	= SCS Runoff	Peak discharge	= 7.854 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 1 min	Hyd. volume	= 25,411 cuft
Drainage area	= 3.440 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 8.00 min
Total precip.	= 3.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

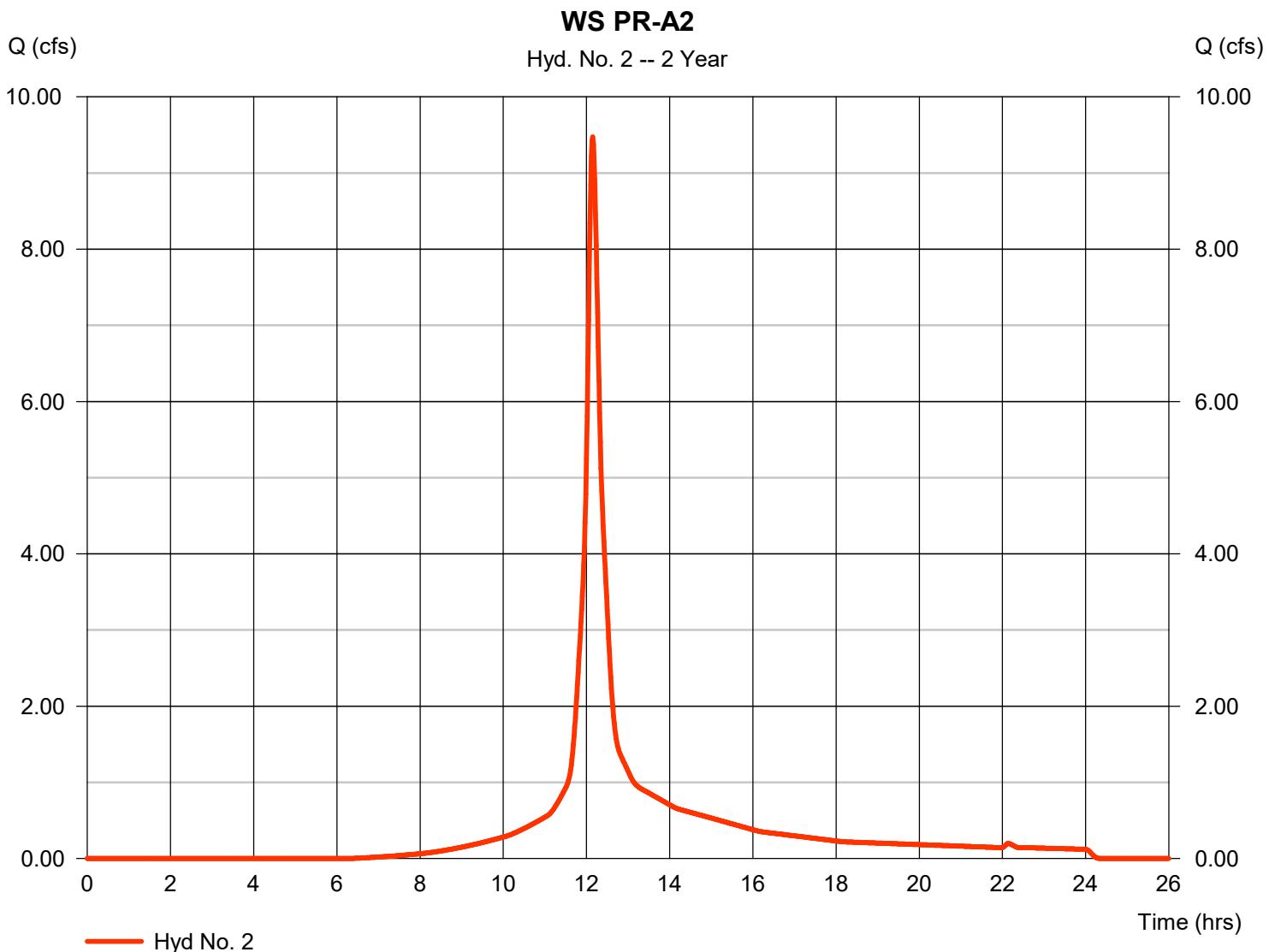
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 2

WS PR-A2

Hydrograph type	= SCS Runoff	Peak discharge	= 9.473 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.15 hrs
Time interval	= 1 min	Hyd. volume	= 35,874 cuft
Drainage area	= 4.620 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.00 min
Total precip.	= 3.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

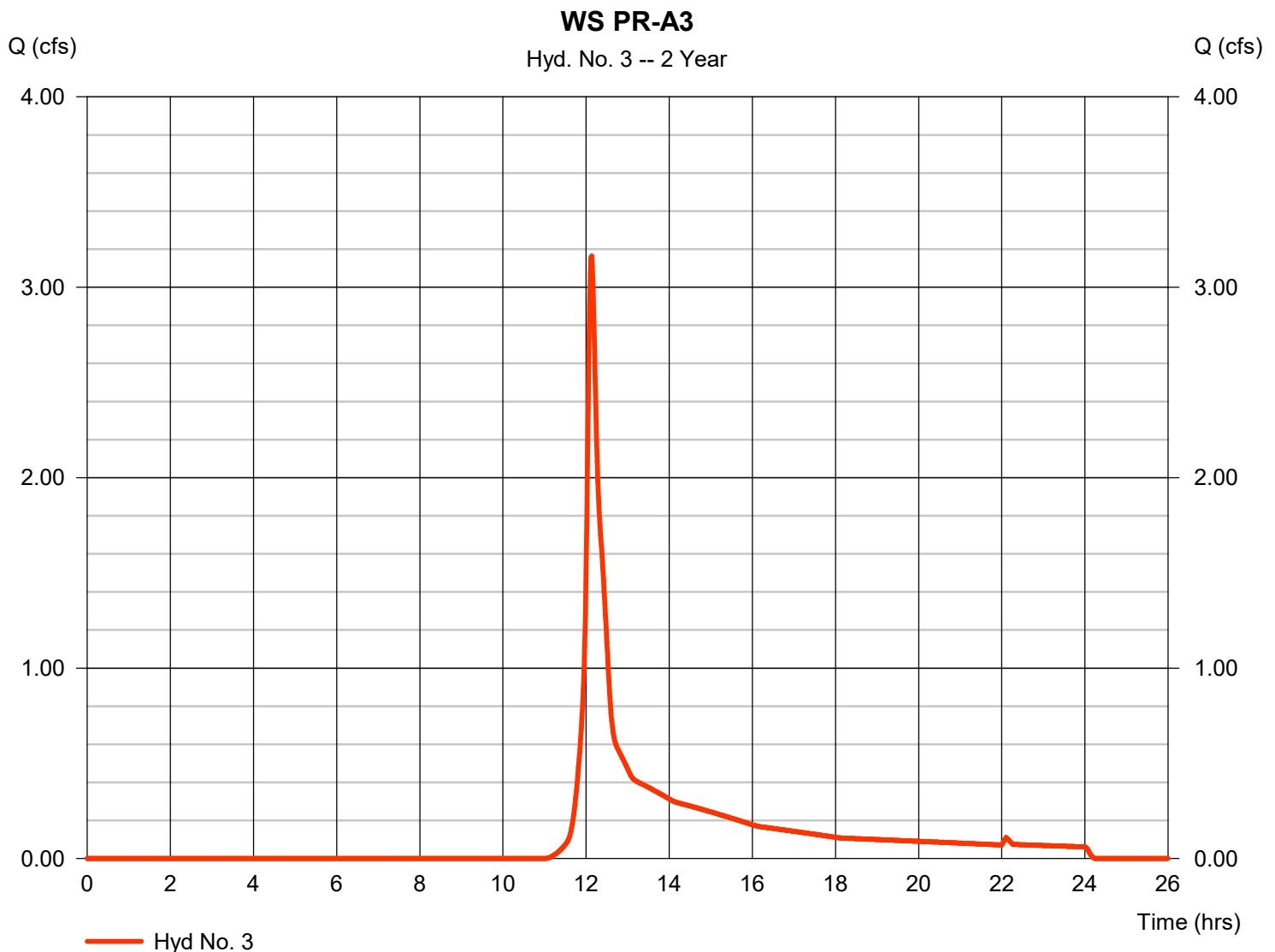
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 3

WS PR-A3

Hydrograph type	= SCS Runoff	Peak discharge	= 3.164 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.13 hrs
Time interval	= 1 min	Hyd. volume	= 11,791 cuft
Drainage area	= 3.460 ac	Curve number	= 71
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

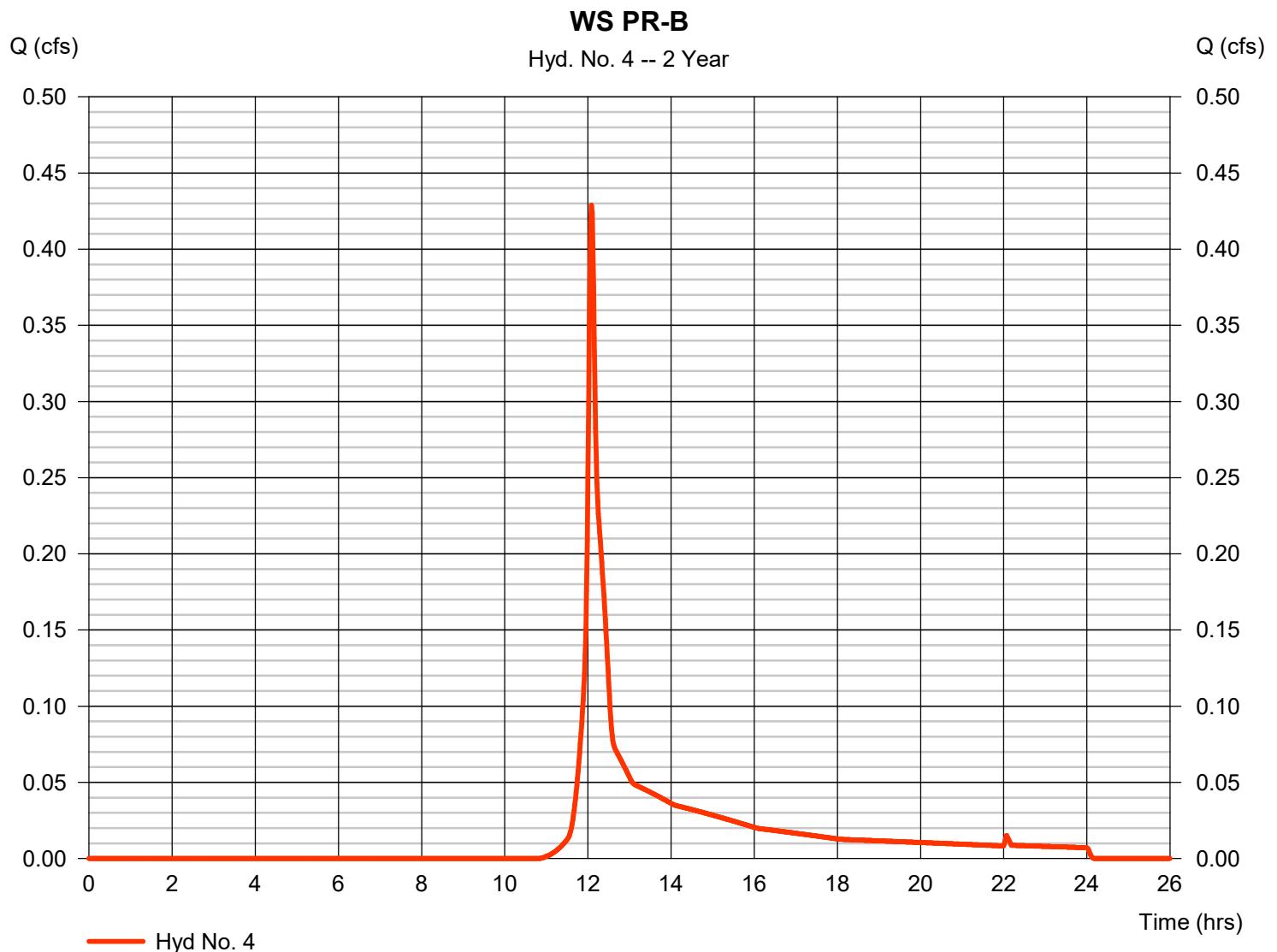
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 4

WS PR-B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.429 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,412 cuft
Drainage area	= 0.380 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

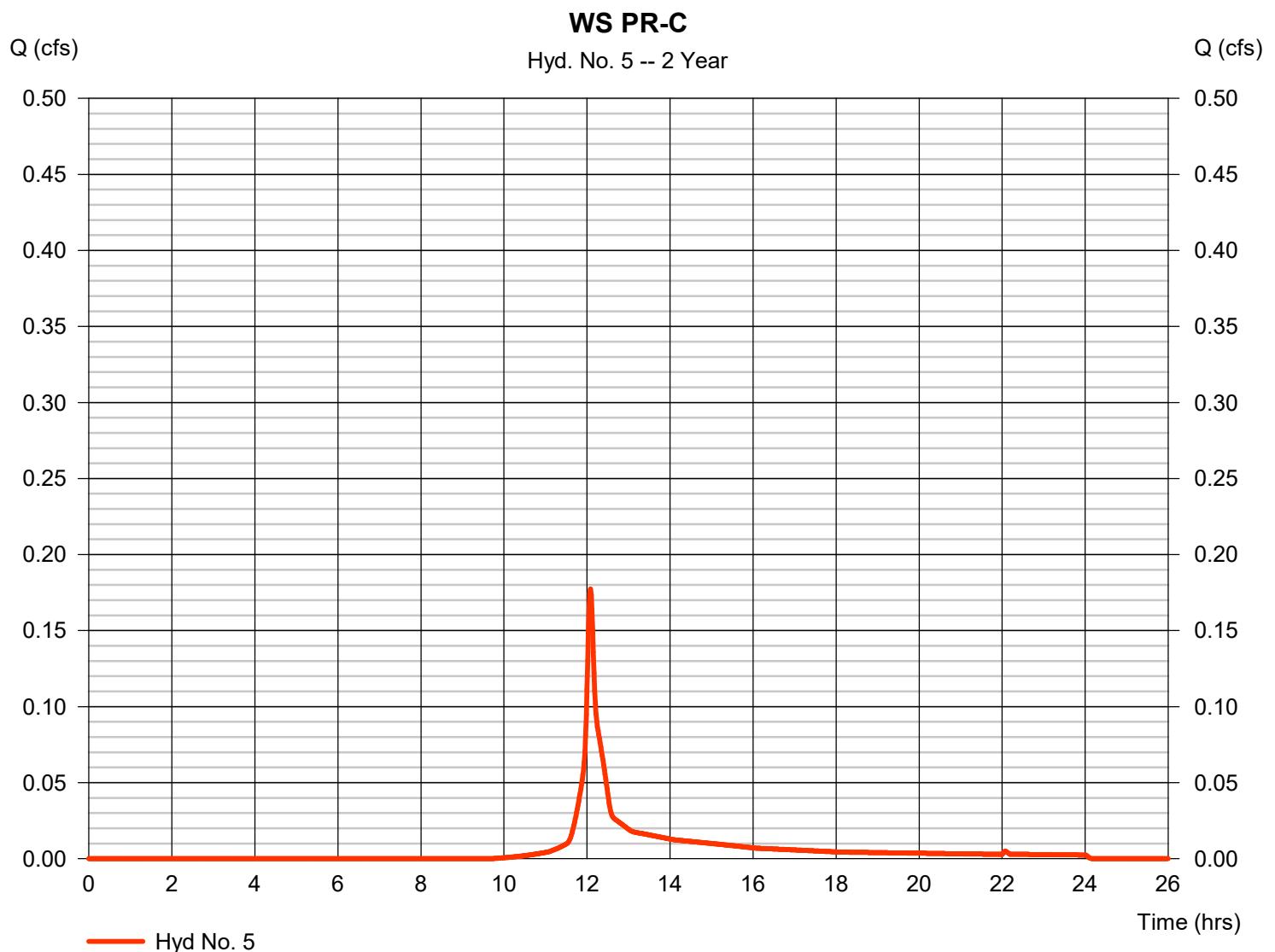
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 5

WS PR-C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.177 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 555 cuft
Drainage area	= 0.110 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

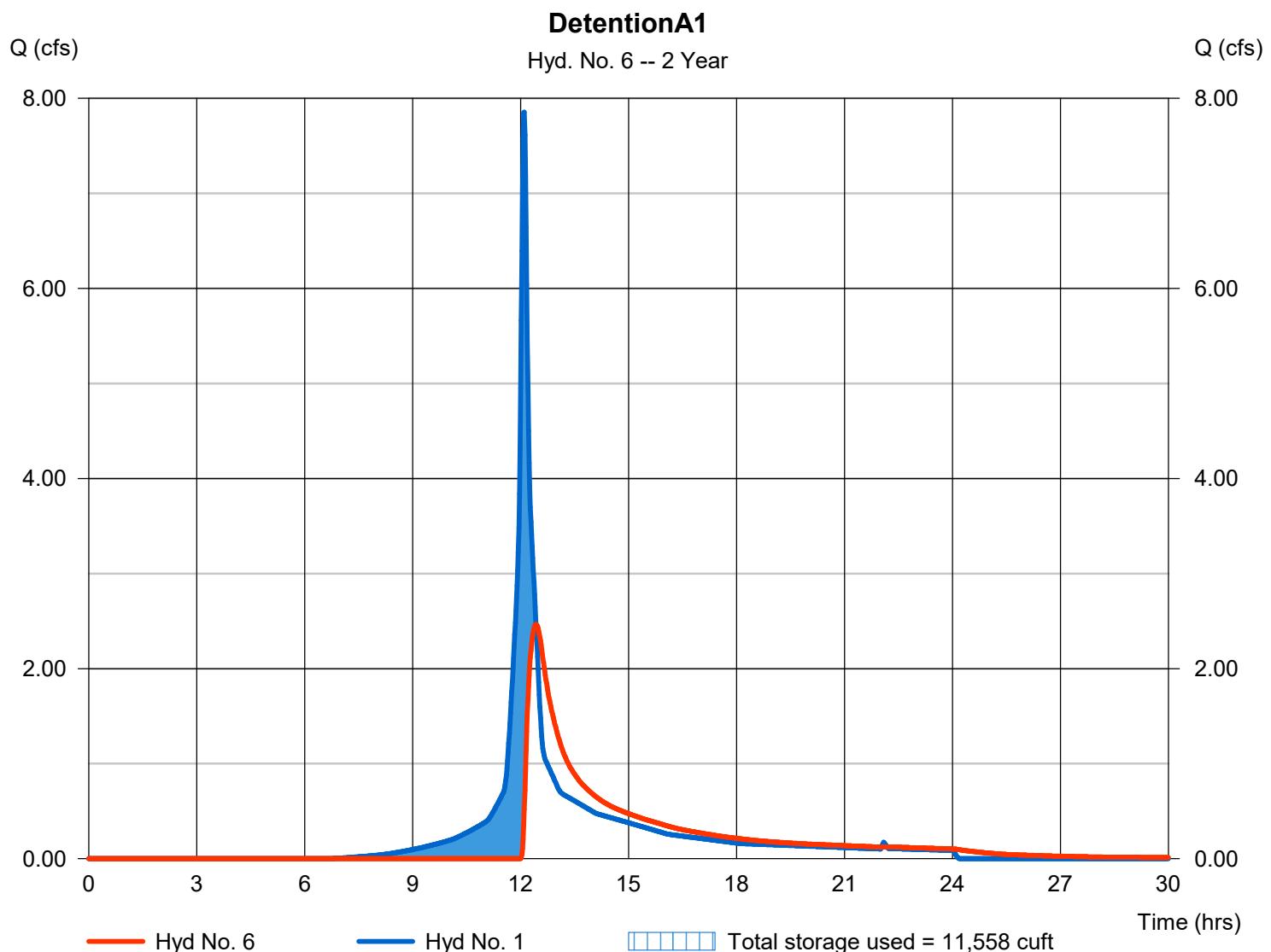
Wednesday, 12 / 26 / 2018

Hyd. No. 6

DetentionA1

Hydrograph type	= Reservoir	Peak discharge	= 2.464 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.42 hrs
Time interval	= 1 min	Hyd. volume	= 19,064 cuft
Inflow hyd. No.	= 1 - WS PR-A1	Max. Elevation	= 48.40 ft
Reservoir name	= Underground Detention A1	Max. Storage	= 11,558 cuft

Storage Indication method used.



Pond Report

9

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Pond No. 1 - Underground Detention A1

Pond Data

UG Chambers -Invert elev. = 47.25 ft, Rise x Span = 2.50 x 3.25 ft, Barrel Len = 155.50 ft, No. Barrels = 13, Slope = 0.00%, Headers = Yes
Encasement -Invert elev. = 46.75 ft, Width = 4.86 ft, Height = 3.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	46.75	n/a	0	0
0.35	47.10	n/a	1,462	1,462
0.70	47.45	n/a	2,299	3,760
1.05	47.80	n/a	2,910	6,670
1.40	48.15	n/a	2,864	9,534
1.75	48.50	n/a	2,784	12,318
2.10	48.85	n/a	2,664	14,982
2.45	49.20	n/a	2,491	17,473
2.80	49.55	n/a	2,226	19,698
3.15	49.90	n/a	1,682	21,380
3.50	50.25	n/a	1,462	22,842

Culvert / Orifice Structures

Weir Structures

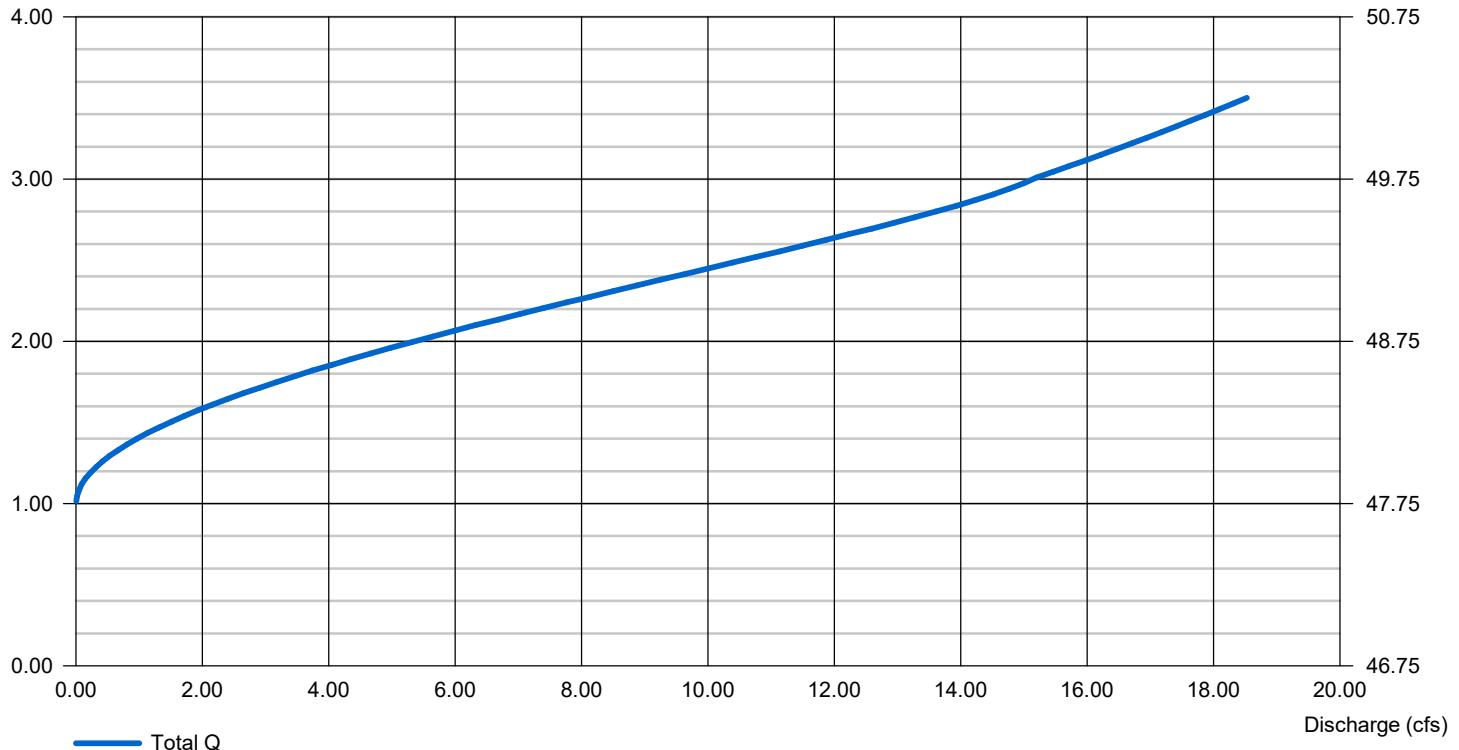
	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]
Rise (in)	= 24.00	Inactive	Inactive	0.00	Crest Len (ft)	Inactive	0.00	0.00	0.00
Span (in)	= 24.00	24.00	6.00	0.00	Crest El. (ft)	= 50.00	0.00	0.00	0.00
No. Barrels	= 1	1	1	0	Weir Coeff.	= 3.33	3.33	3.33	3.33
Invert El. (ft)	= 47.75	47.75	48.25	0.00	Weir Type	= Rect	---	---	---
Length (ft)	= 48.00	0.00	0.00	0.00	Multi-Stage	= Yes	No	No	No
Slope (%)	= 3.12	0.00	0.00	n/a	Exfil.(in/hr)	= 0.000 (by Wet area)			
N-Value	= .013	.013	.013	n/a	TW Elev. (ft)	= 0.00			
Orifice Coeff.	= 0.60	0.60	0.60	0.60					
Multi-Stage	= n/a	Yes	Yes	No					

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage (ft)

Stage / Discharge

Elev (ft)



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

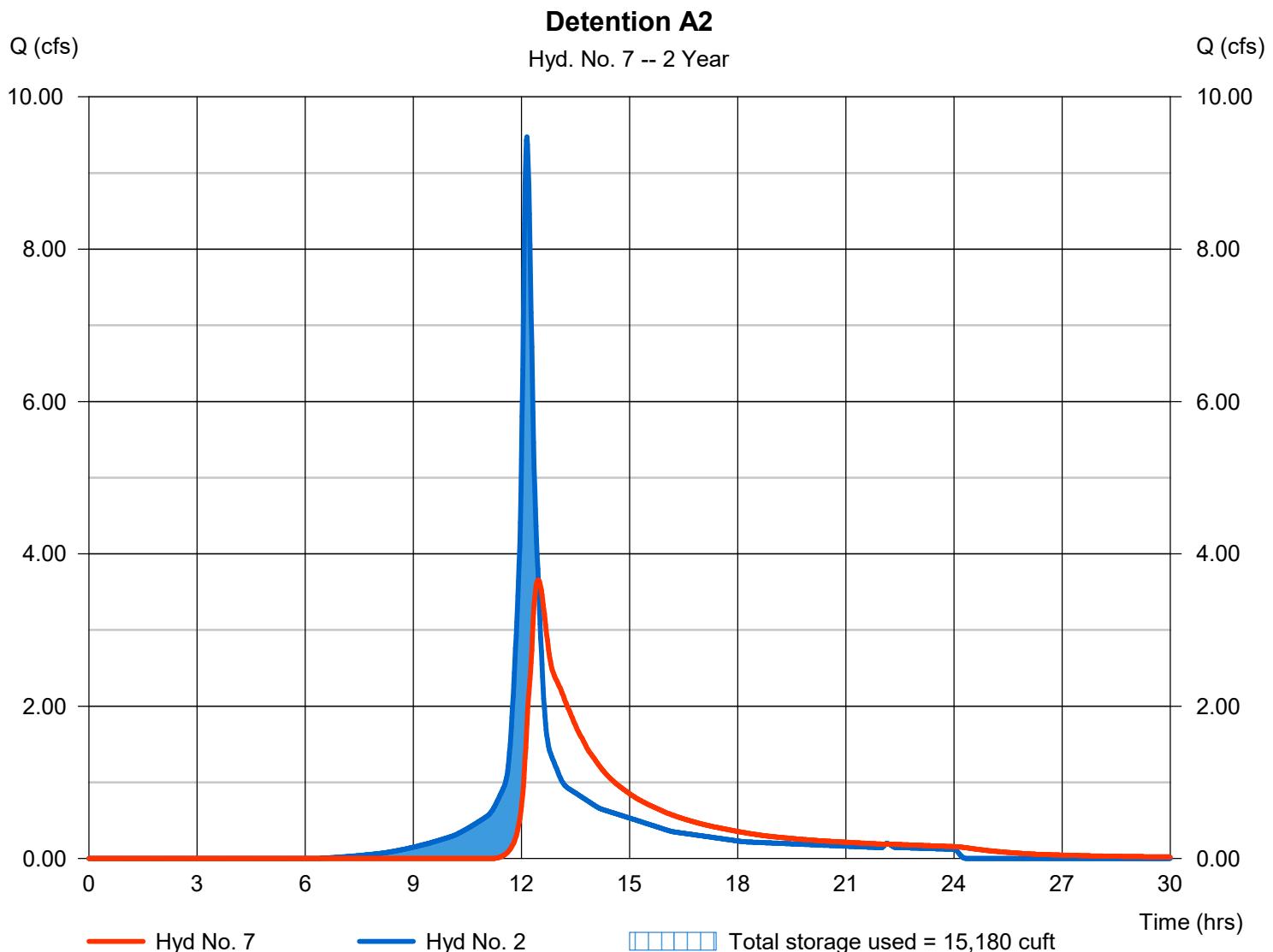
Wednesday, 12 / 26 / 2018

Hyd. No. 7

Detention A2

Hydrograph type	= Reservoir	Peak discharge	= 3.655 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.47 hrs
Time interval	= 1 min	Hyd. volume	= 32,607 cuft
Inflow hyd. No.	= 2 - WS PR-A2	Max. Elevation	= 46.71 ft
Reservoir name	= Underground Detention A2	Max. Storage	= 15,180 cuft

Storage Indication method used.



Pond Report

11

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Pond No. 2 - Underground Detention A2

Pond Data

UG Chambers -Invert elev. = 45.50 ft, Rise x Span = 2.50 x 3.35 ft, Barrel Len = 213.75 ft, No. Barrels = 12, Slope = 0.00%, Headers = Yes
Encasement -Invert elev. = 45.00 ft, Width = 4.88 ft, Height = 3.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	45.00	n/a	0	0
0.35	45.35	n/a	1,833	1,833
0.70	45.70	n/a	2,910	4,743
1.05	46.05	n/a	3,697	8,440
1.40	46.40	n/a	3,637	12,077
1.75	46.75	n/a	3,535	15,612
2.10	47.10	n/a	3,381	18,992
2.45	47.45	n/a	3,157	22,149
2.80	47.80	n/a	2,816	24,965
3.15	48.15	n/a	2,117	27,082
3.50	48.50	n/a	1,833	28,915

Culvert / Orifice Structures

Weir Structures

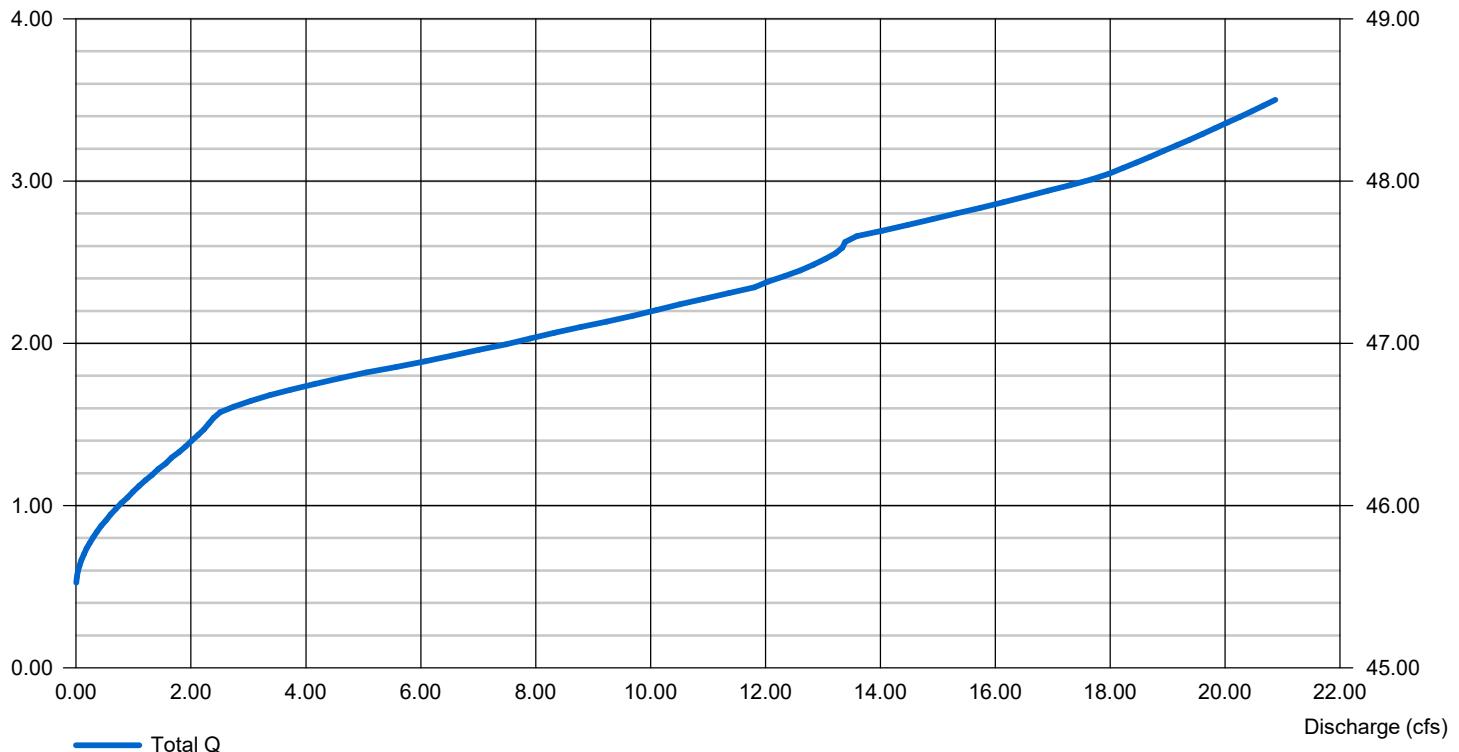
	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]
Rise (in)	= 24.00	12.00	Inactive	0.00	Crest Len (ft)	= 6.00	0.00	0.00	0.00
Span (in)	= 24.00	12.00	8.00	0.00	Crest El. (ft)	= 46.55	0.00	0.00	0.00
No. Barrels	= 1	1	1	0	Weir Coeff.	= 3.33	3.33	3.33	3.33
Invert El. (ft)	= 45.50	45.50	46.00	0.00	Weir Type	= Rect	---	---	---
Length (ft)	= 22.00	0.00	0.00	0.00	Multi-Stage	= Yes	No	No	No
Slope (%)	= 2.25	0.00	0.00	n/a	Exfil.(in/hr)	= 0.000 (by Wet area)			
N-Value	= .013	.013	.013	n/a	TW Elev. (ft)	= 0.00			
Orifice Coeff.	= 0.60	0.60	0.60	0.60					
Multi-Stage	= n/a	Yes	Yes	No					

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage (ft)

Stage / Discharge

Elev (ft)



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

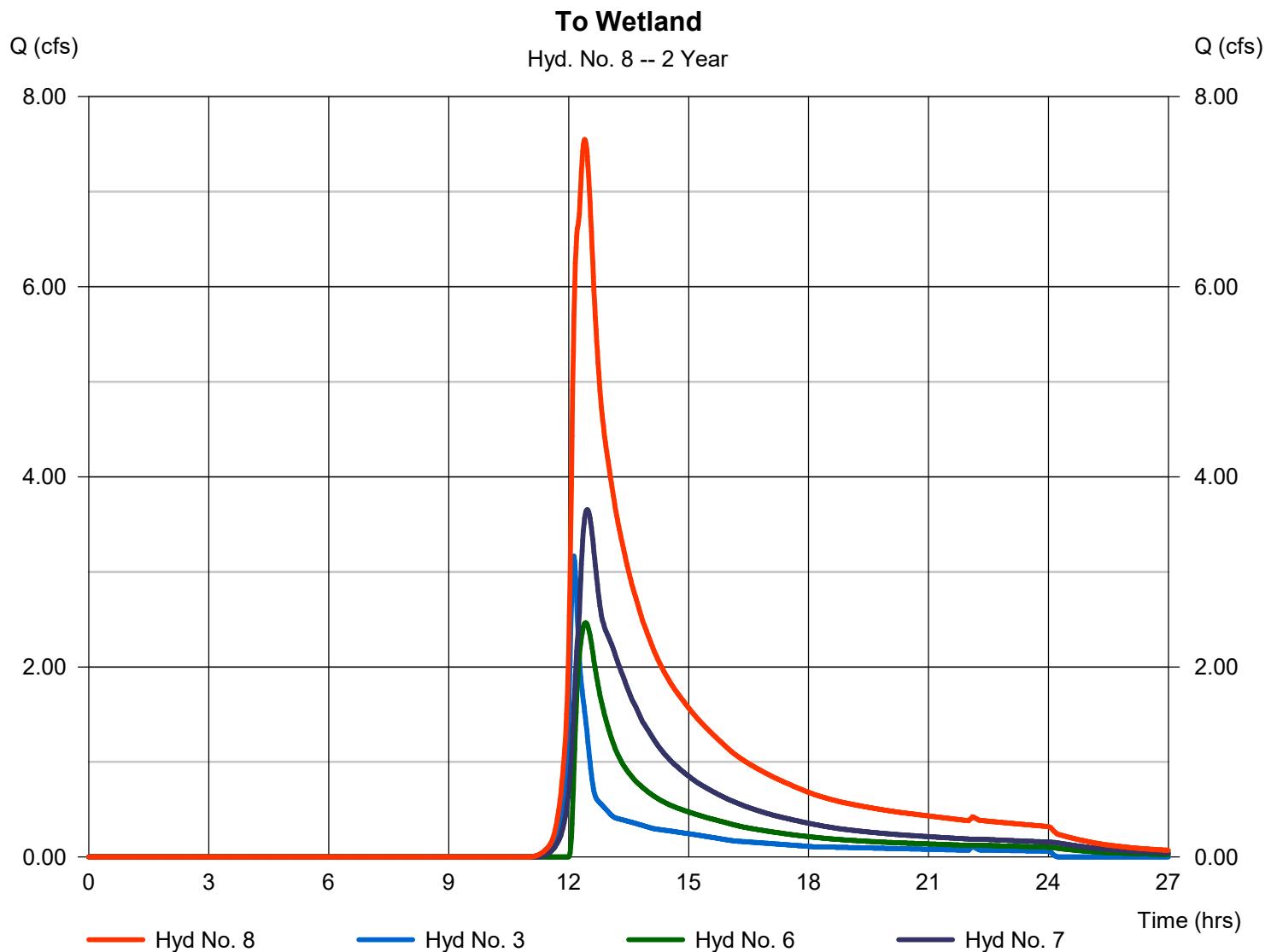
Wednesday, 12 / 26 / 2018

Hyd. No. 8

To Wetland

Hydrograph type = Combine
 Storm frequency = 2 yrs
 Time interval = 1 min
 Inflow hyds. = 3, 6, 7

Peak discharge = 7.551 cfs
 Time to peak = 12.40 hrs
 Hyd. volume = 63,462 cuft
 Contrib. drain. area = 3.460 ac



Hydrograph Report

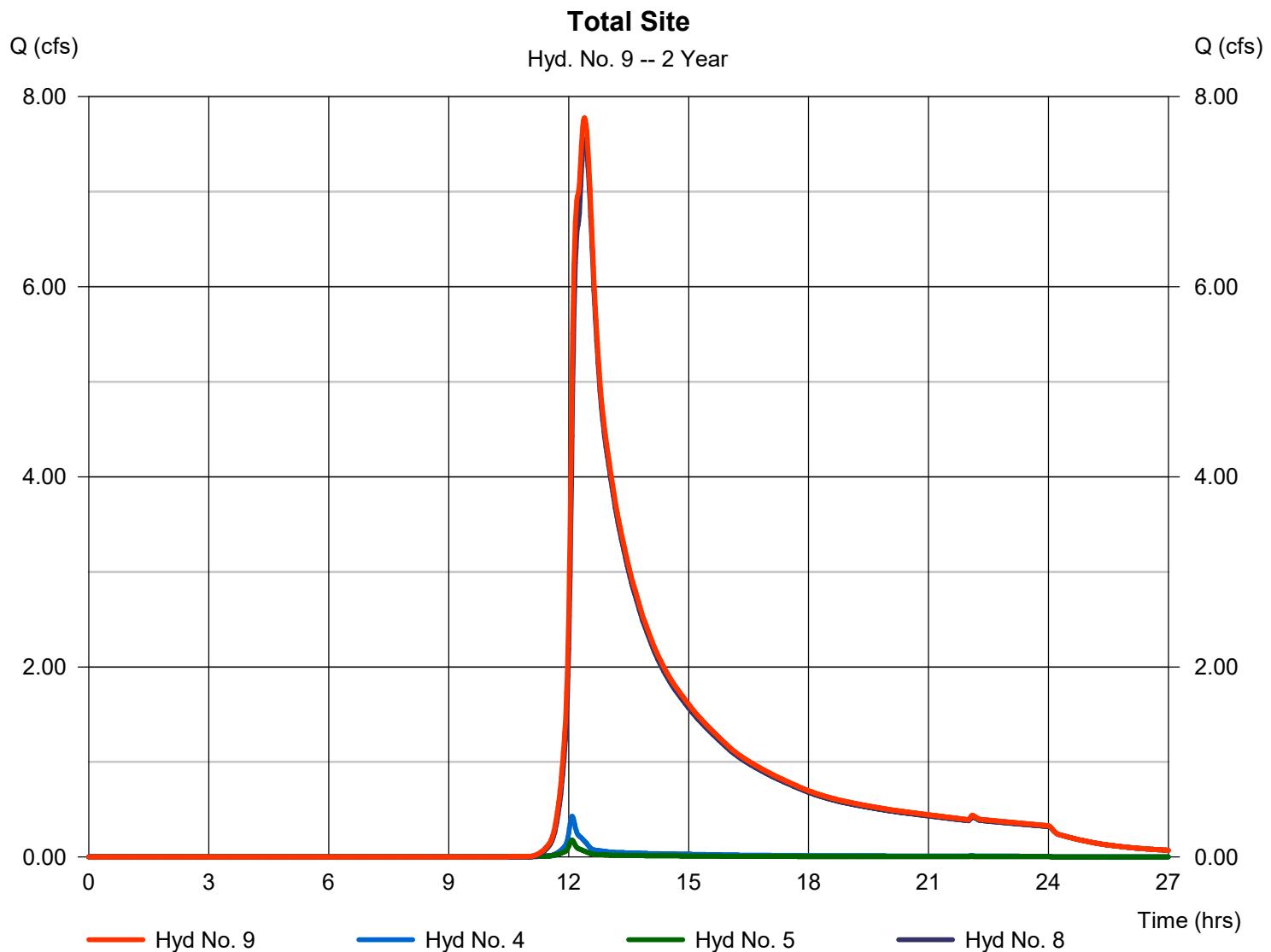
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 9

Total Site

Hydrograph type	= Combine	Peak discharge	= 7.777 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 1 min	Hyd. volume	= 65,428 cuft
Inflow hyds.	= 4, 5, 8	Contrib. drain. area	= 0.490 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	14.56	1	725	48,147	----	----	----	WS PR-A1
2	SCS Runoff	17.26	1	729	67,021	----	----	----	WS PR-A2
3	SCS Runoff	8.527	1	727	29,463	----	----	----	WS PR-A3
4	SCS Runoff	1.117	1	725	3,459	----	----	----	WS PR-B
5	SCS Runoff	0.397	1	725	1,222	----	----	----	WS PR-C
6	Reservoir	8.807	1	732	41,798	1	49.09	16,677	DetentionA1
7	Reservoir	11.52	1	738	63,746	2	47.32	20,999	Detention A2
8	Combine	25.98	1	732	135,007	3, 6, 7	----	----	To Wetland
9	Combine	26.85	1	731	139,688	4, 5, 8	----	----	Total Site
proposed.gpw				Return Period: 10 Year				Wednesday, 12 / 26 / 2018	

Hydrograph Report

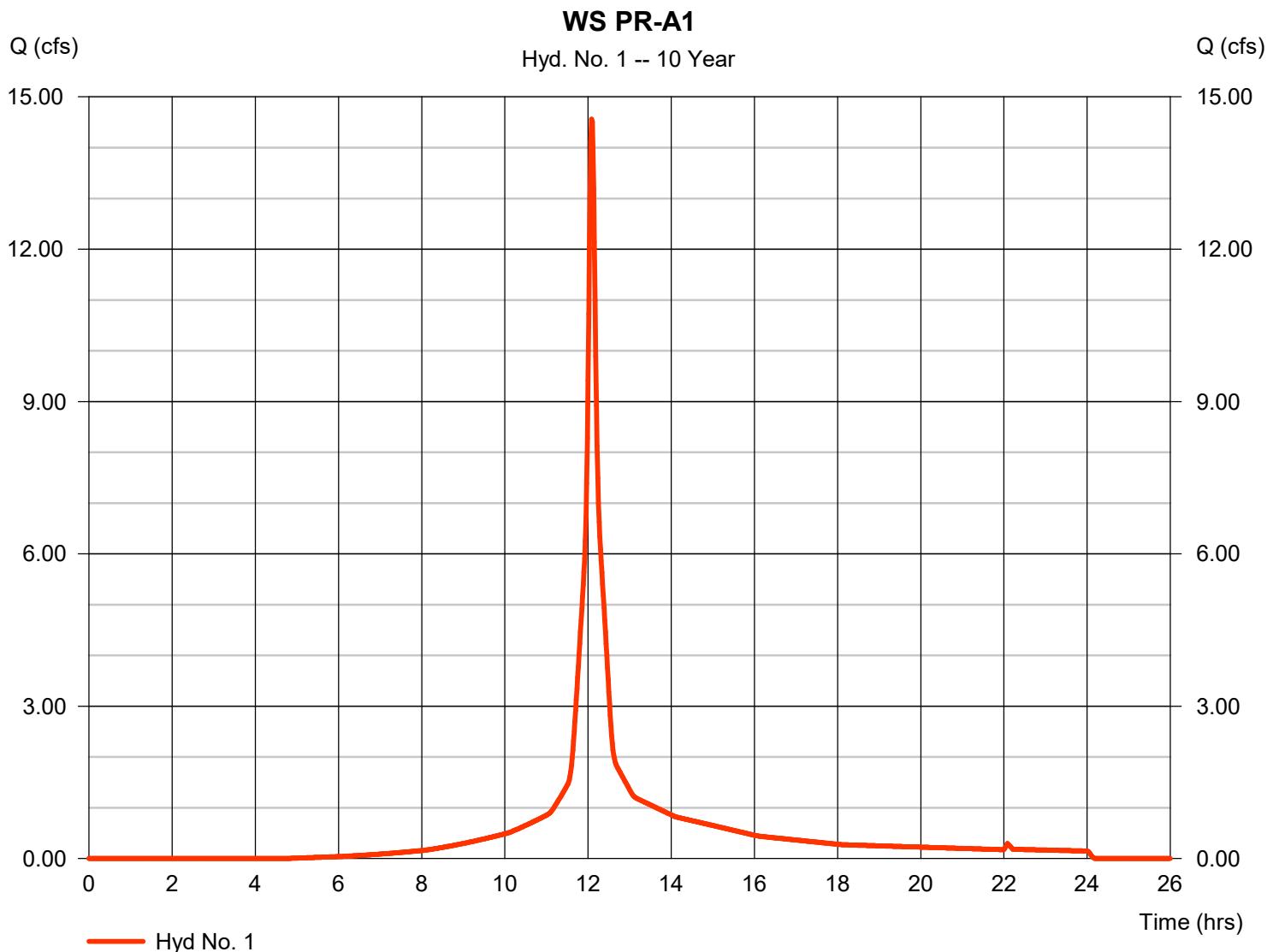
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 1

WS PR-A1

Hydrograph type	= SCS Runoff	Peak discharge	= 14.56 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 48,147 cuft
Drainage area	= 3.440 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 8.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

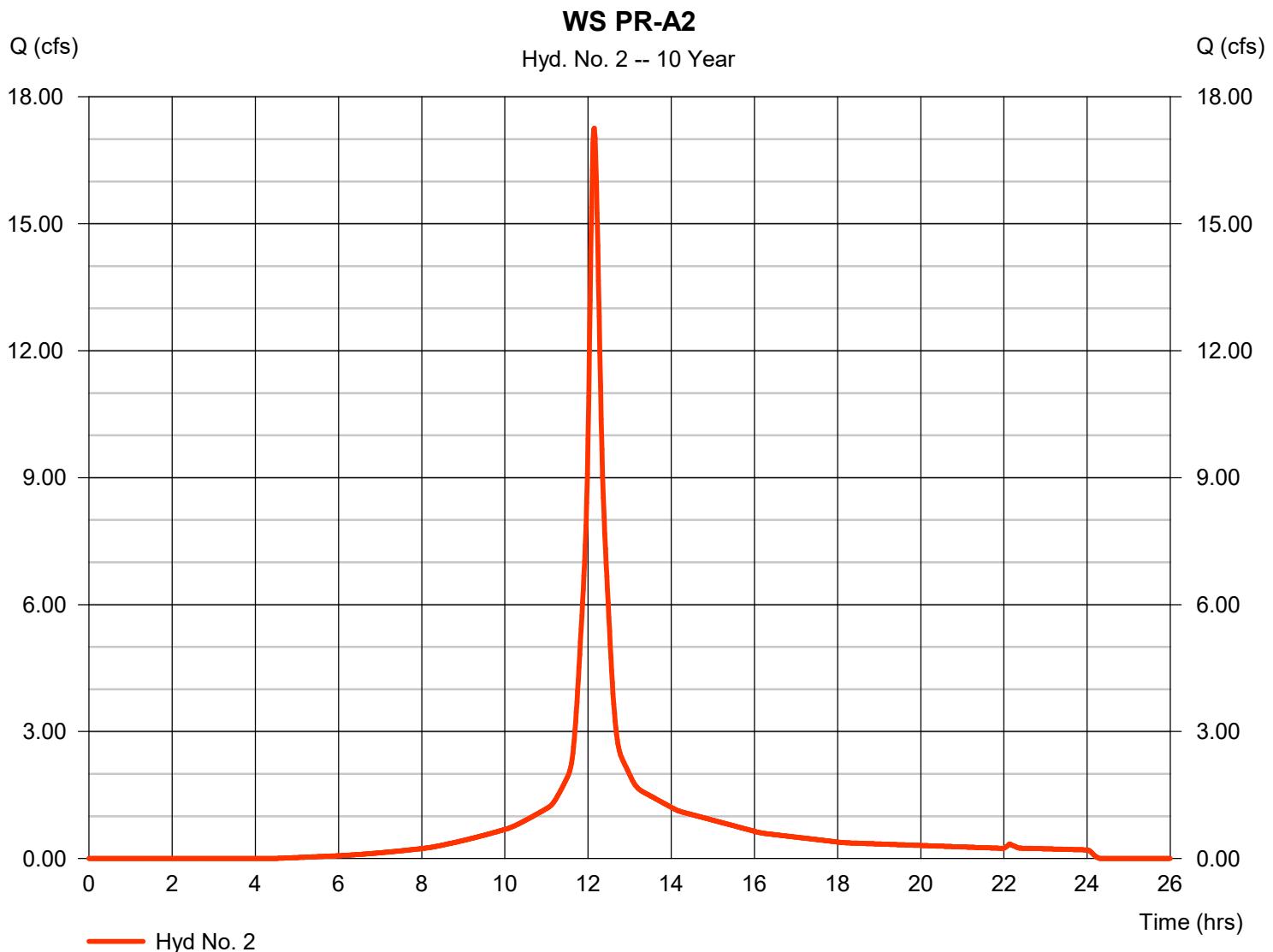
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 2

WS PR-A2

Hydrograph type	= SCS Runoff	Peak discharge	= 17.26 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.15 hrs
Time interval	= 1 min	Hyd. volume	= 67,021 cuft
Drainage area	= 4.620 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

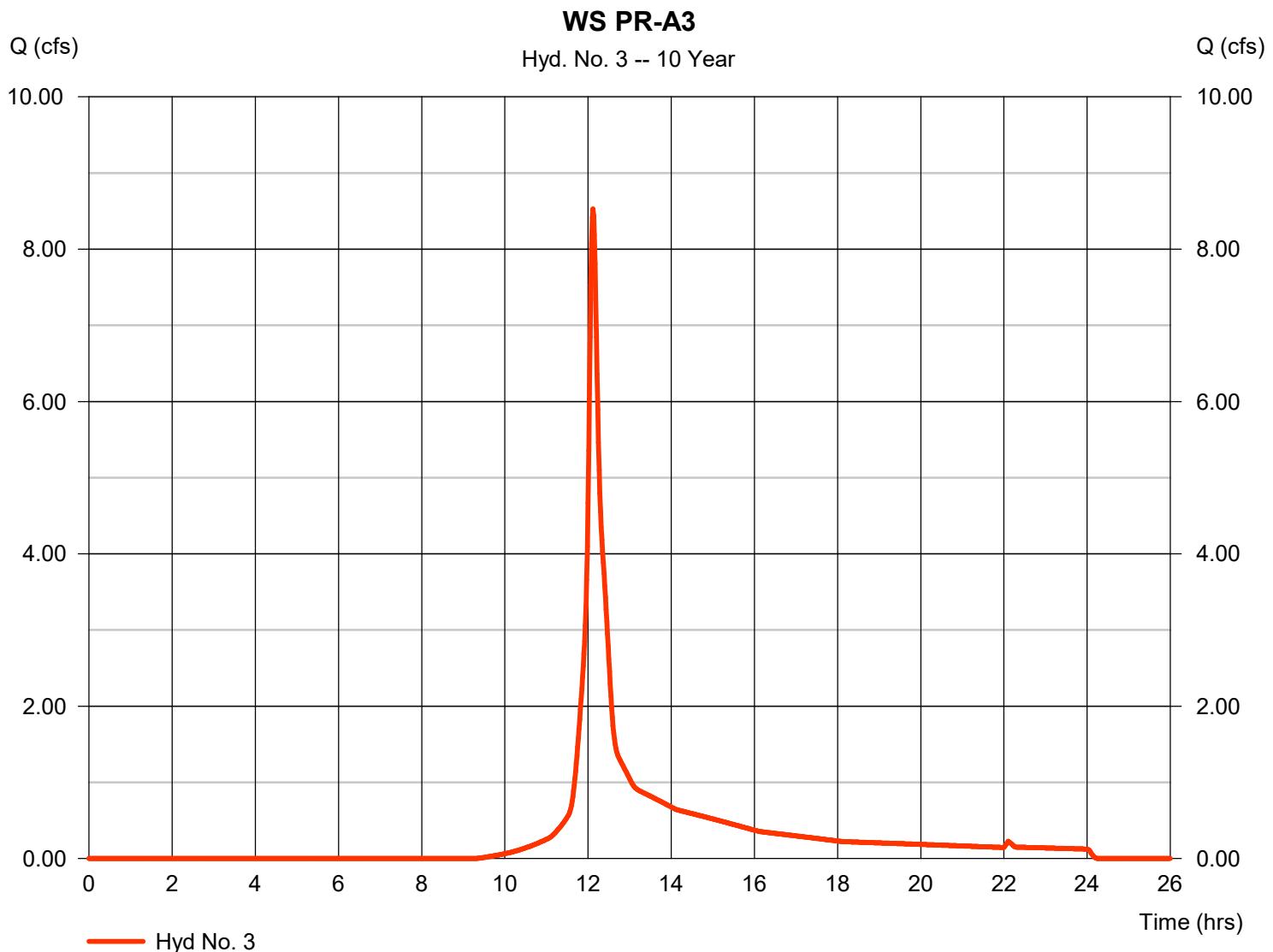
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 3

WS PR-A3

Hydrograph type	= SCS Runoff	Peak discharge	= 8.527 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.12 hrs
Time interval	= 1 min	Hyd. volume	= 29,463 cuft
Drainage area	= 3.460 ac	Curve number	= 71
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

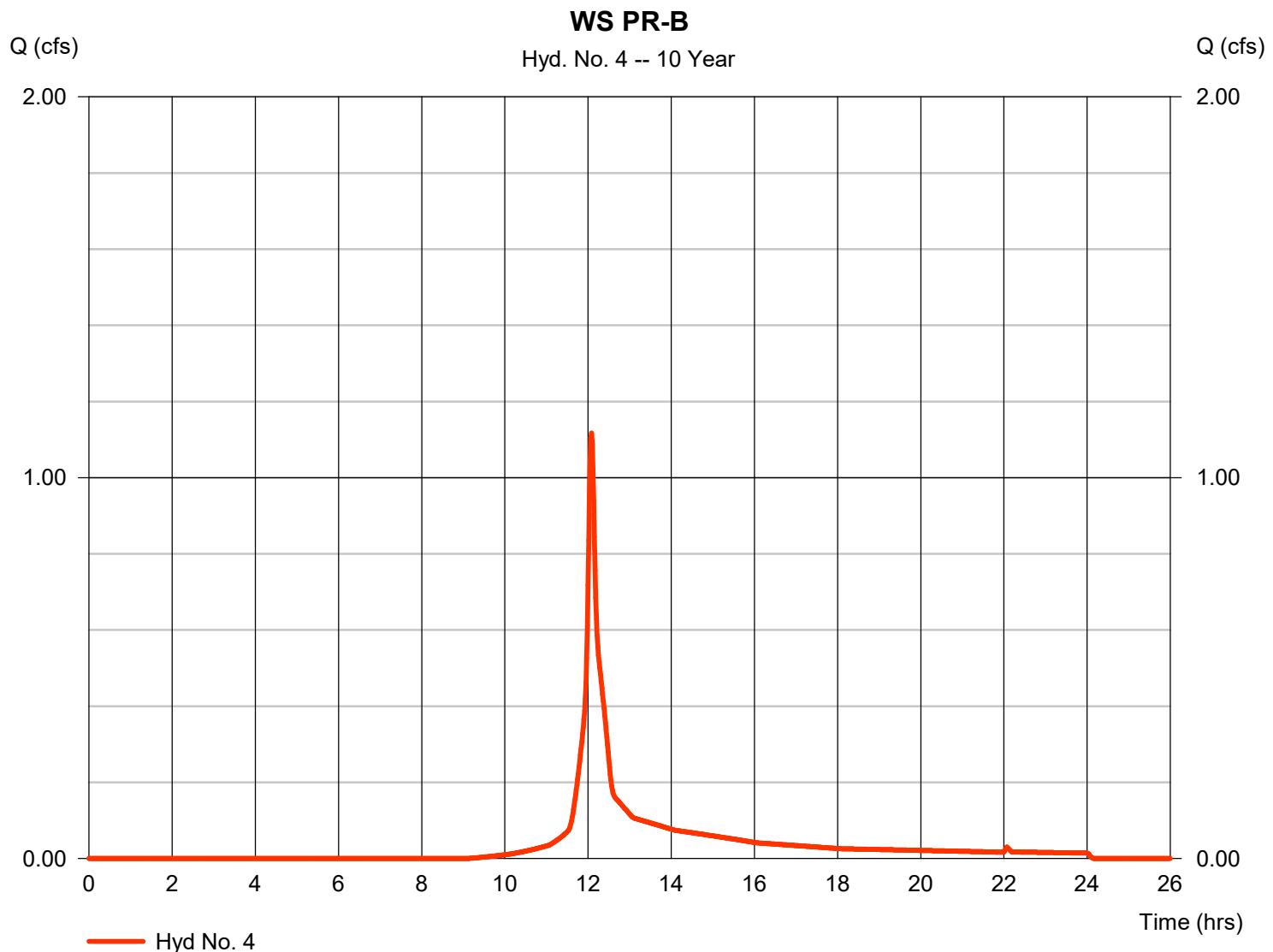
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 4

WS PR-B

Hydrograph type	= SCS Runoff	Peak discharge	= 1.117 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 3,459 cuft
Drainage area	= 0.380 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

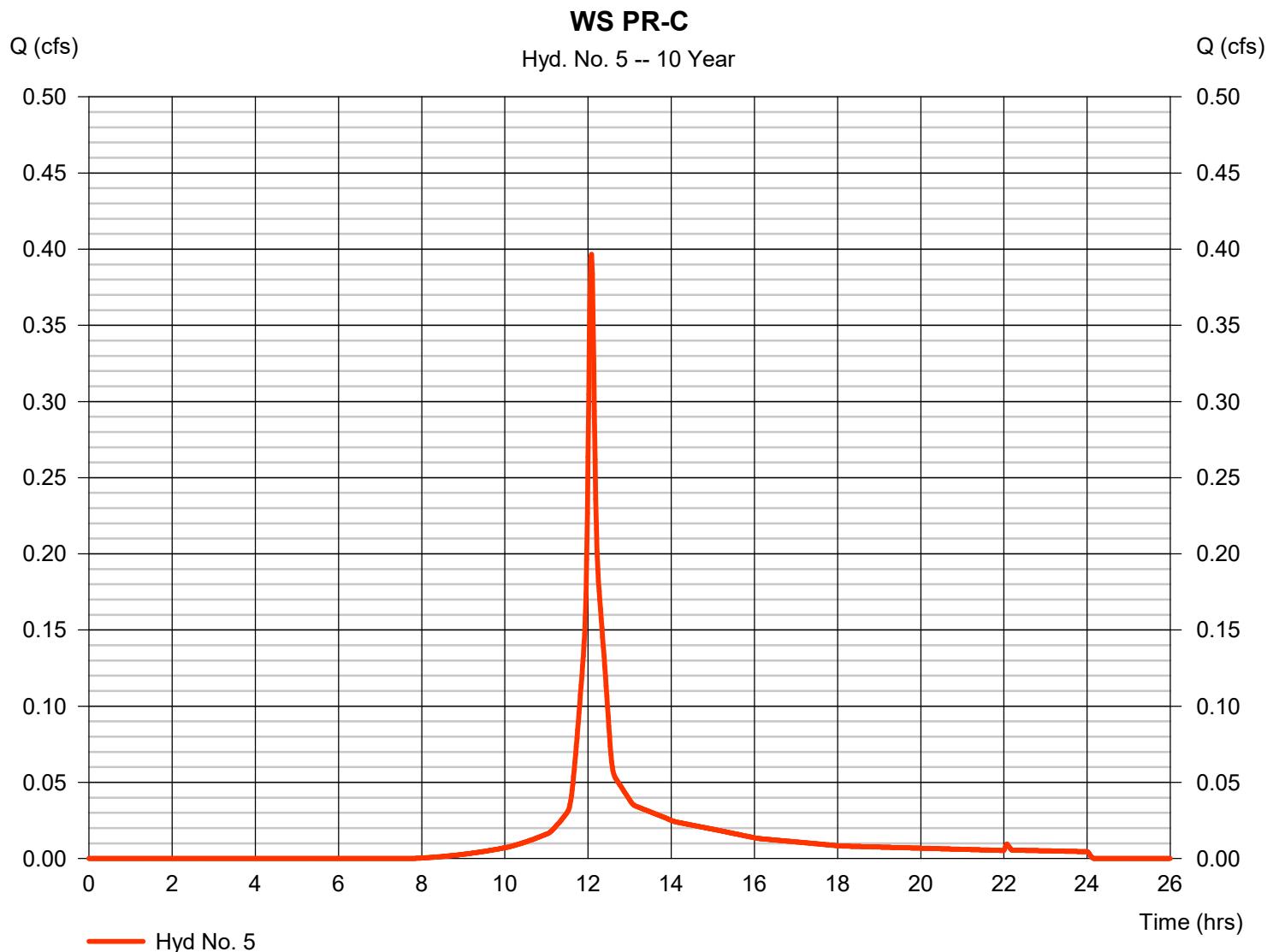
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 5

WS PR-C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.397 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,222 cuft
Drainage area	= 0.110 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

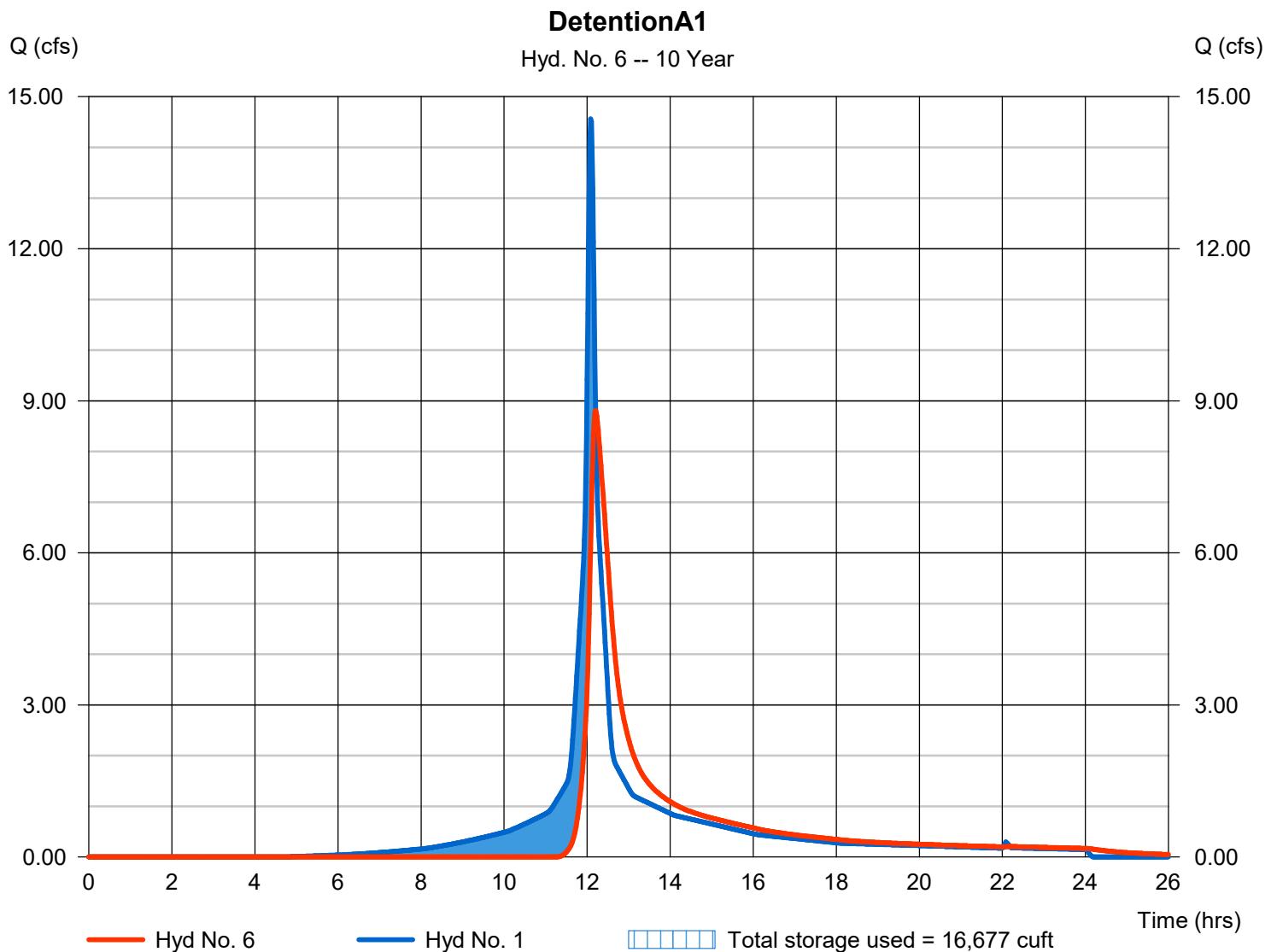
Wednesday, 12 / 26 / 2018

Hyd. No. 6

DetentionA1

Hydrograph type	= Reservoir	Peak discharge	= 8.807 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.20 hrs
Time interval	= 1 min	Hyd. volume	= 41,798 cuft
Inflow hyd. No.	= 1 - WS PR-A1	Max. Elevation	= 49.09 ft
Reservoir name	= Underground Detention A1	Max. Storage	= 16,677 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

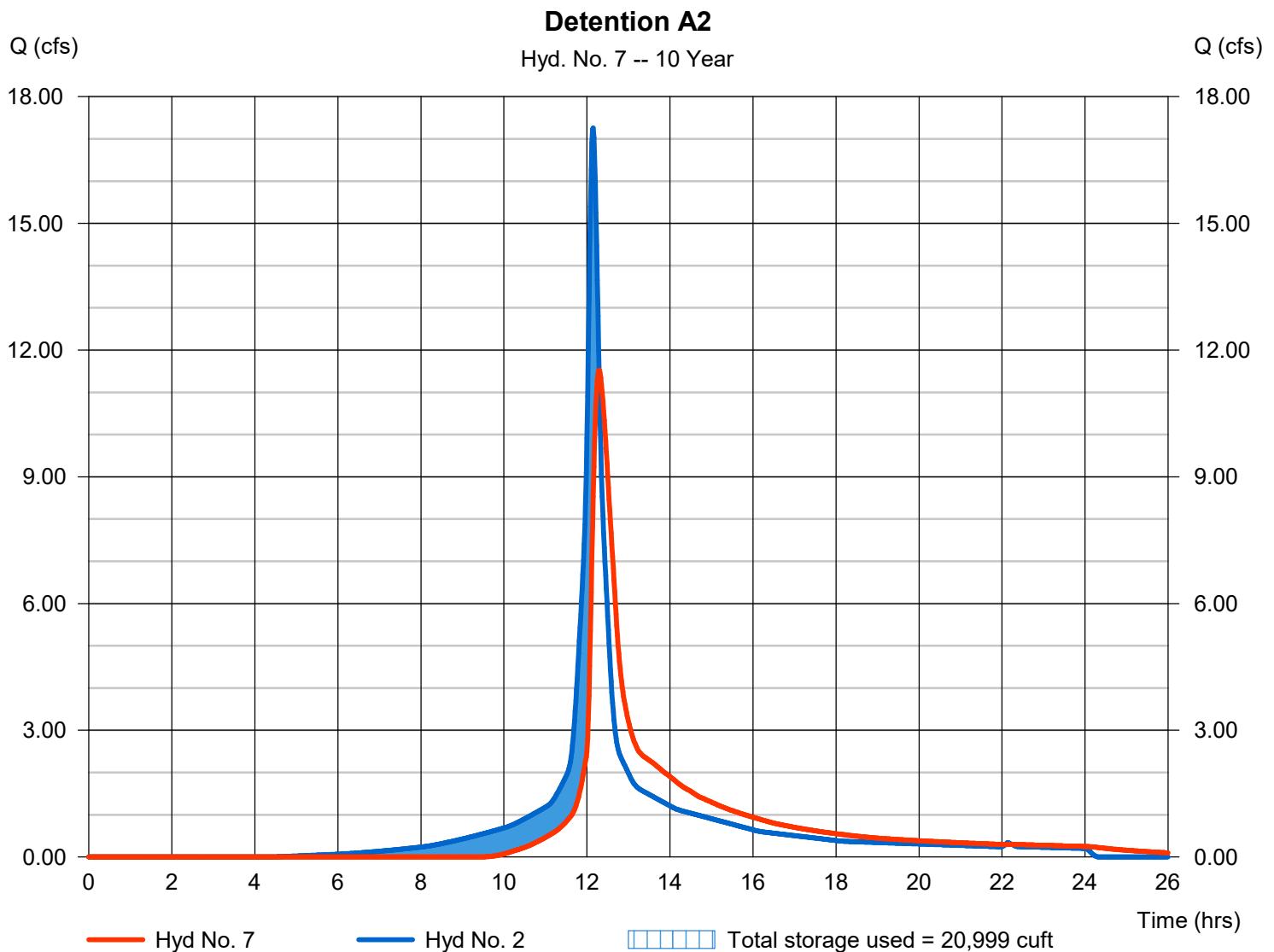
Wednesday, 12 / 26 / 2018

Hyd. No. 7

Detention A2

Hydrograph type	= Reservoir	Peak discharge	= 11.52 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.30 hrs
Time interval	= 1 min	Hyd. volume	= 63,746 cuft
Inflow hyd. No.	= 2 - WS PR-A2	Max. Elevation	= 47.32 ft
Reservoir name	= Underground Detention A2	Max. Storage	= 20,999 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

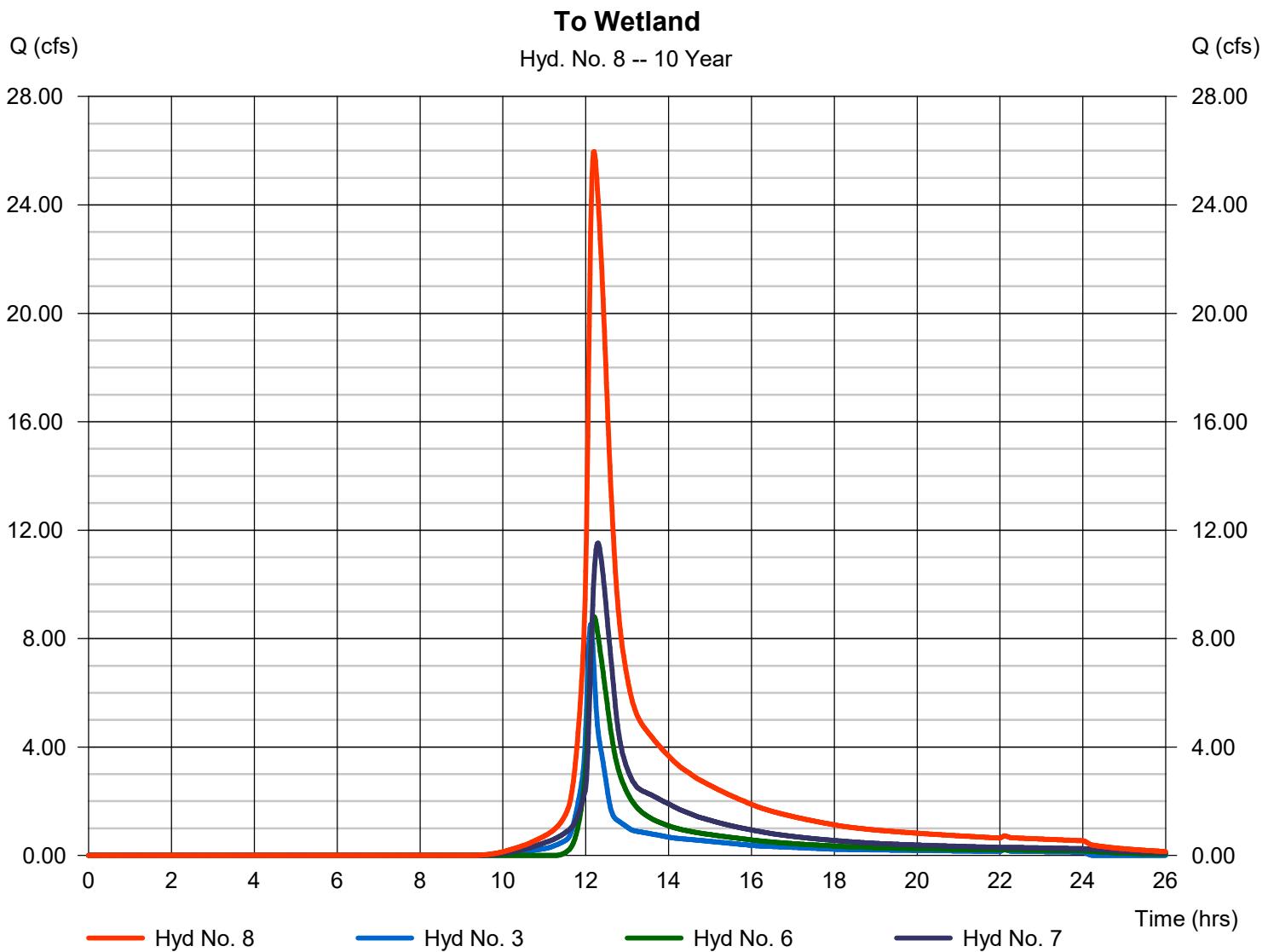
Wednesday, 12 / 26 / 2018

Hyd. No. 8

To Wetland

Hydrograph type = Combine
 Storm frequency = 10 yrs
 Time interval = 1 min
 Inflow hyds. = 3, 6, 7

Peak discharge = 25.98 cfs
 Time to peak = 12.20 hrs
 Hyd. volume = 135,007 cuft
 Contrib. drain. area = 3.460 ac



Hydrograph Report

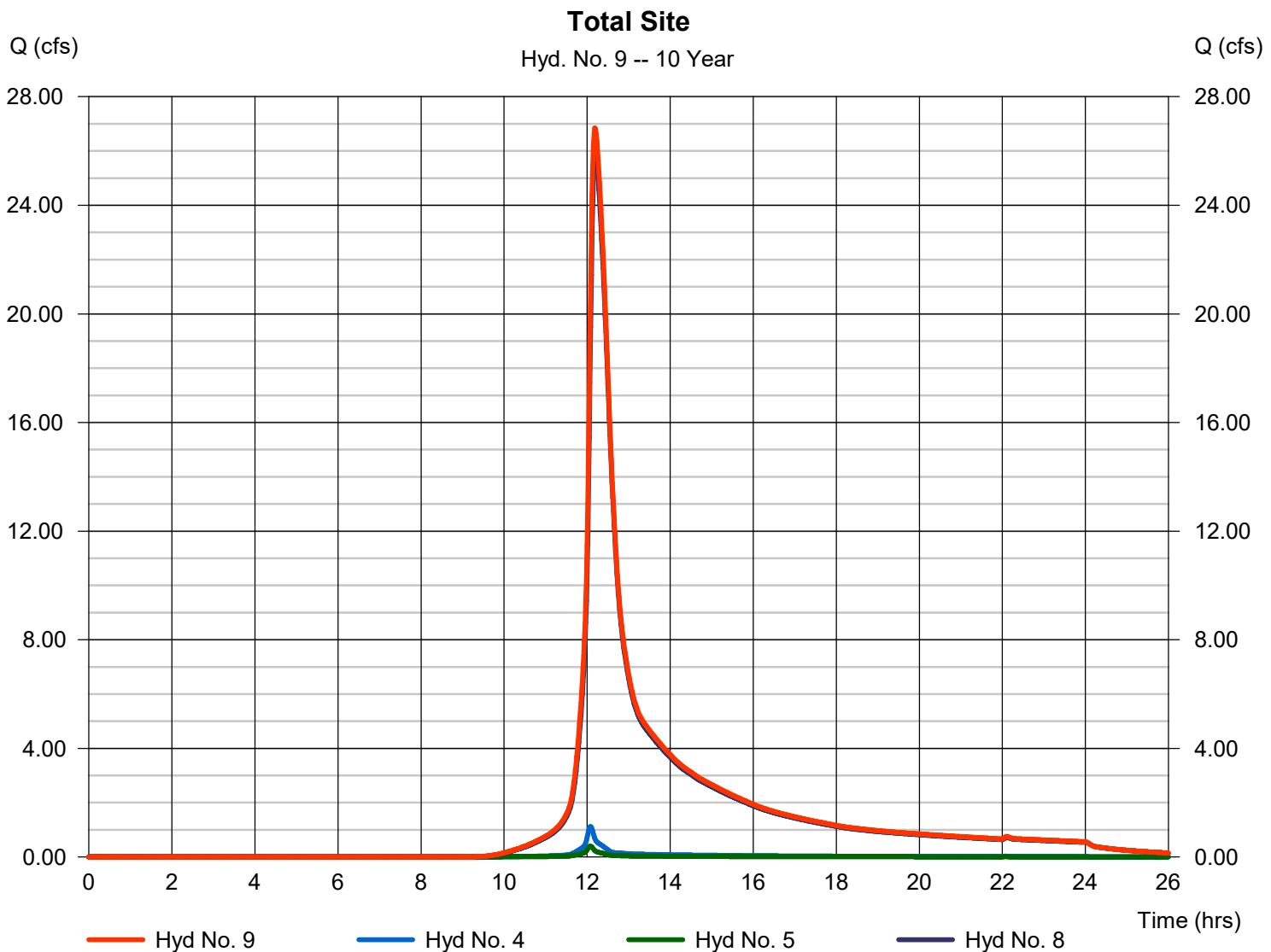
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 9

Total Site

Hydrograph type	= Combine	Peak discharge	= 26.85 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.18 hrs
Time interval	= 1 min	Hyd. volume	= 139,688 cuft
Inflow hyds.	= 4, 5, 8	Contrib. drain. area	= 0.490 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	18.71	1	725	62,669	----	----	----	WS PR-A1
2	SCS Runoff	22.06	1	729	86,831	----	----	----	WS PR-A2
3	SCS Runoff	12.24	1	727	41,945	----	----	----	WS PR-A3
4	SCS Runoff	1.589	1	725	4,894	----	----	----	WS PR-B
5	SCS Runoff	0.540	1	725	1,672	----	----	----	WS PR-C
6	Reservoir	12.35	1	731	56,318	1	49.42	18,882	DetentionA1
7	Reservoir	14.58	1	738	83,554	2	47.74	24,472	Detention A2
8	Combine	36.12	1	730	181,817	3, 6, 7	----	----	To Wetland
9	Combine	37.53	1	729	188,382	4, 5, 8	----	----	Total Site
proposed.gpw				Return Period: 25 Year				Wednesday, 12 / 26 / 2018	

Hydrograph Report

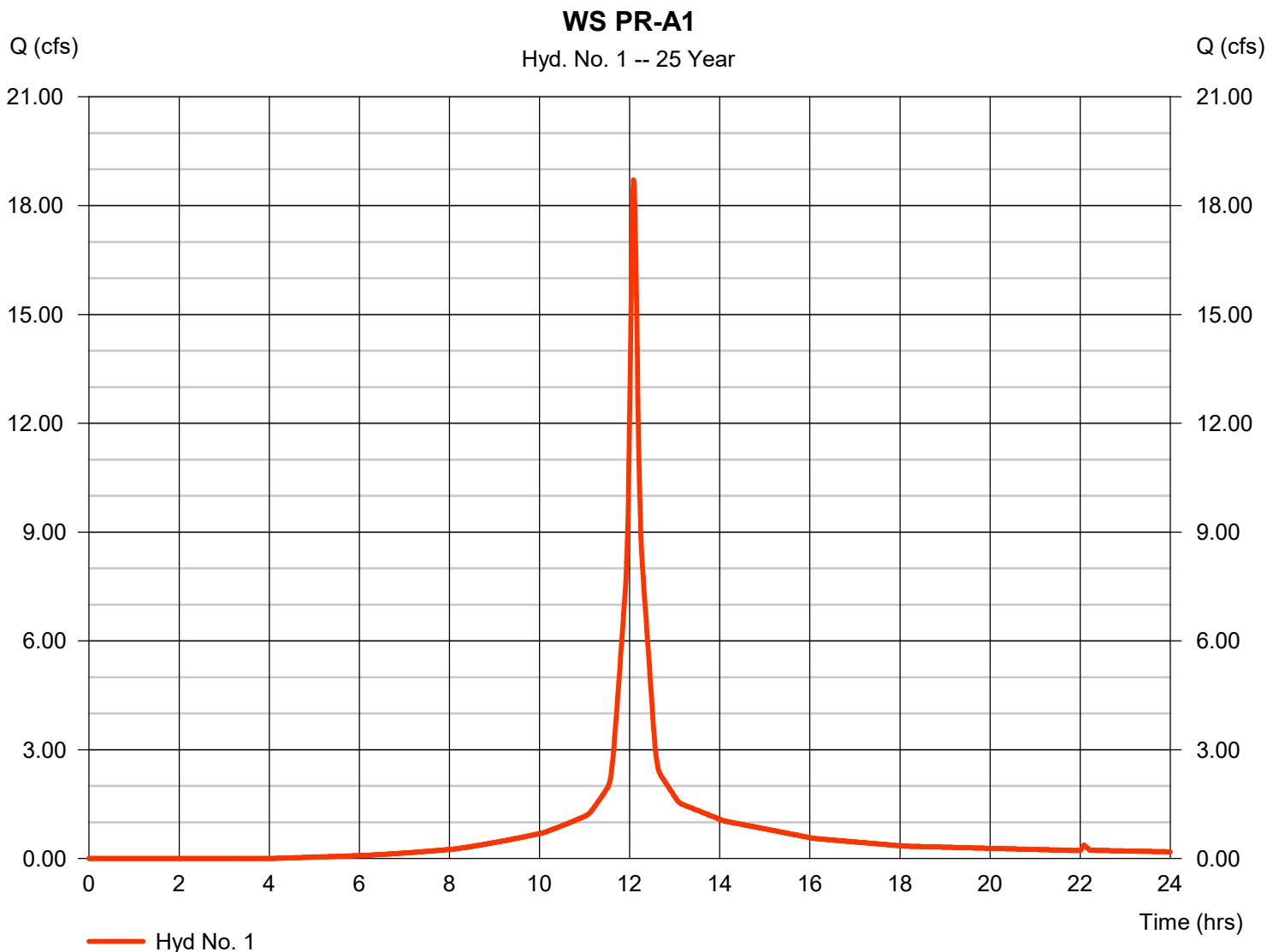
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 1

WS PR-A1

Hydrograph type	= SCS Runoff	Peak discharge	= 18.71 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 62,669 cuft
Drainage area	= 3.440 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 8.00 min
Total precip.	= 6.54 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

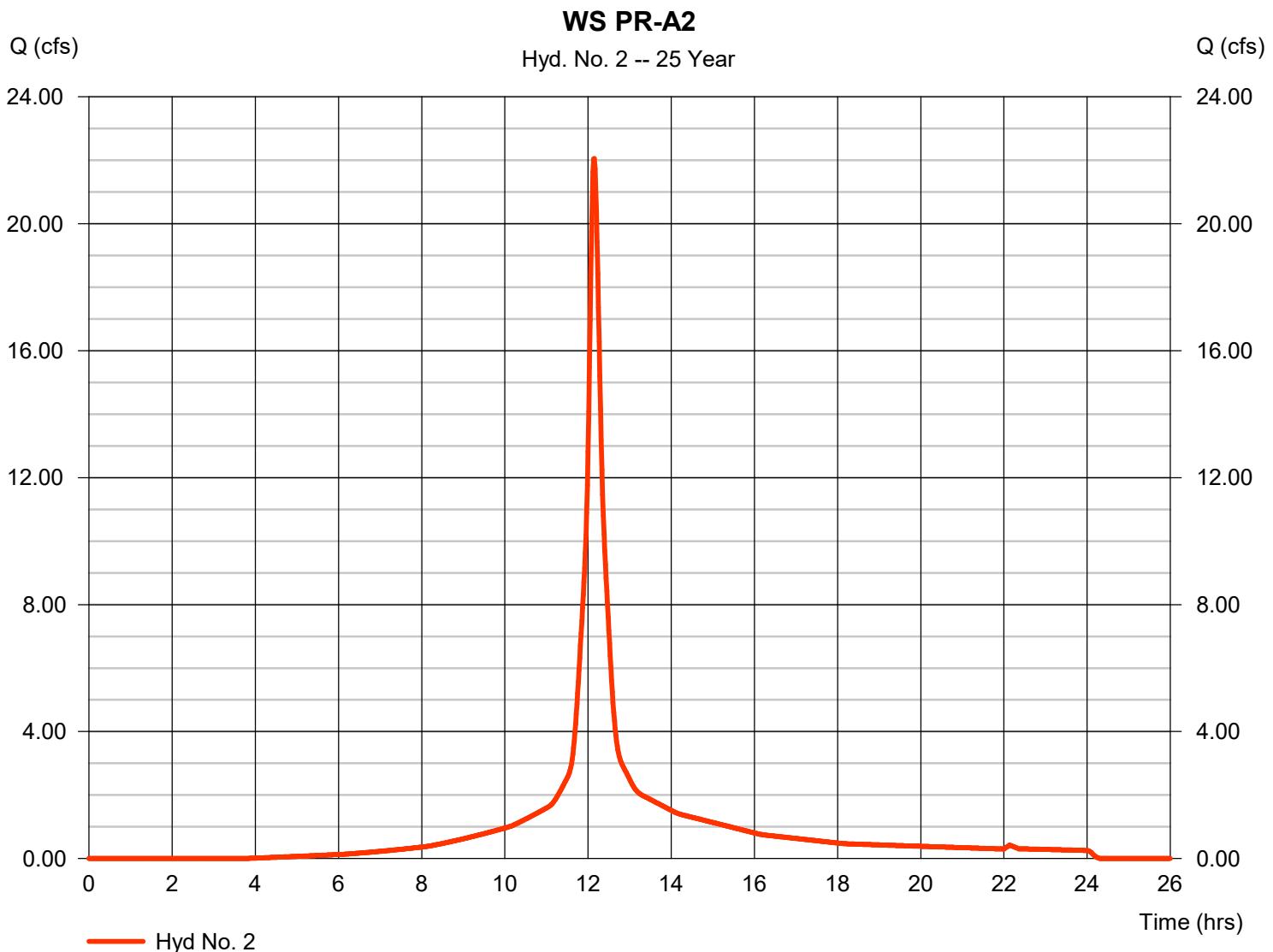
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 2

WS PR-A2

Hydrograph type	= SCS Runoff	Peak discharge	= 22.06 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.15 hrs
Time interval	= 1 min	Hyd. volume	= 86,831 cuft
Drainage area	= 4.620 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.00 min
Total precip.	= 6.54 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

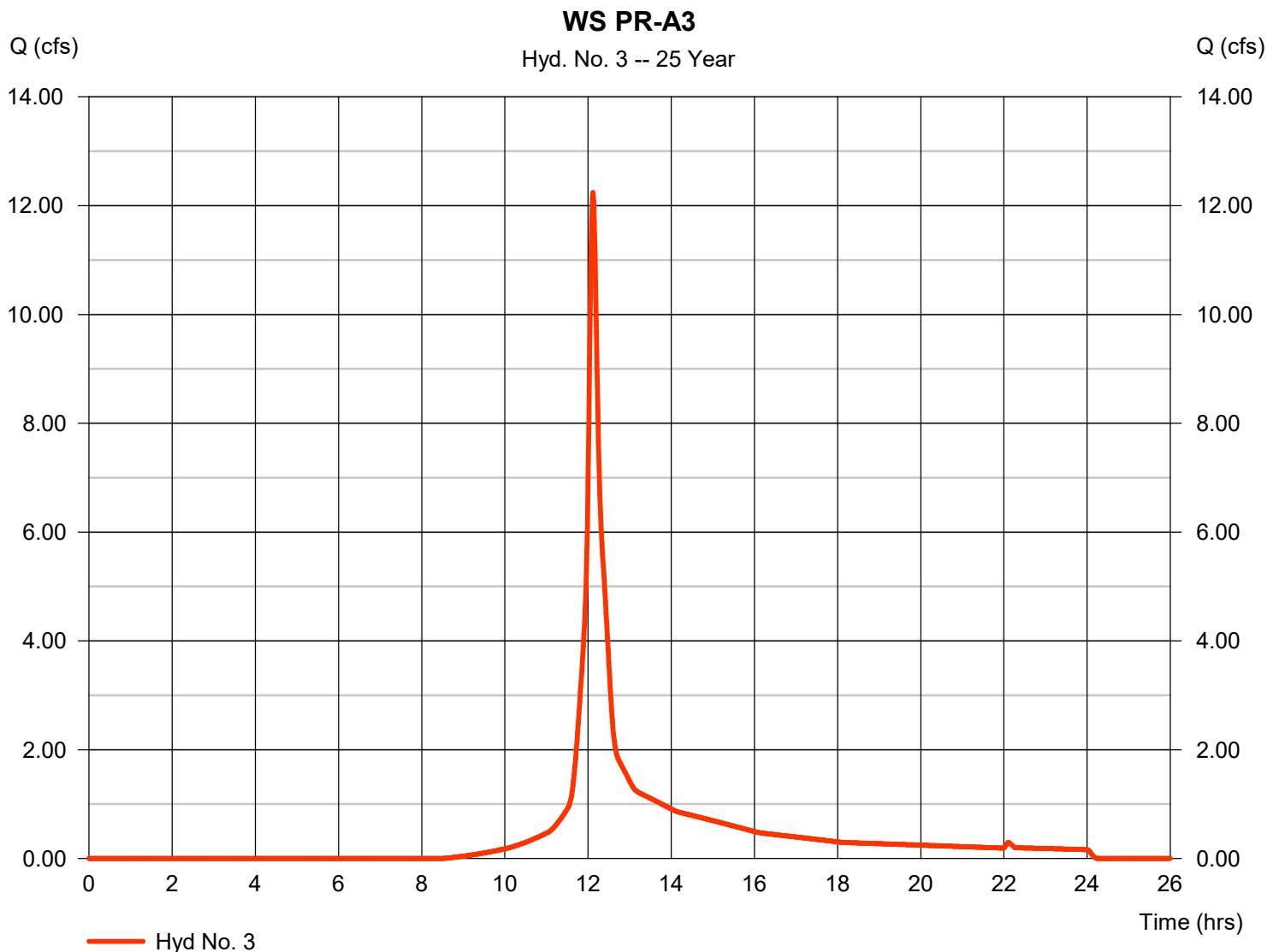
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 3

WS PR-A3

Hydrograph type	= SCS Runoff	Peak discharge	= 12.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.12 hrs
Time interval	= 1 min	Hyd. volume	= 41,945 cuft
Drainage area	= 3.460 ac	Curve number	= 71
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 6.54 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

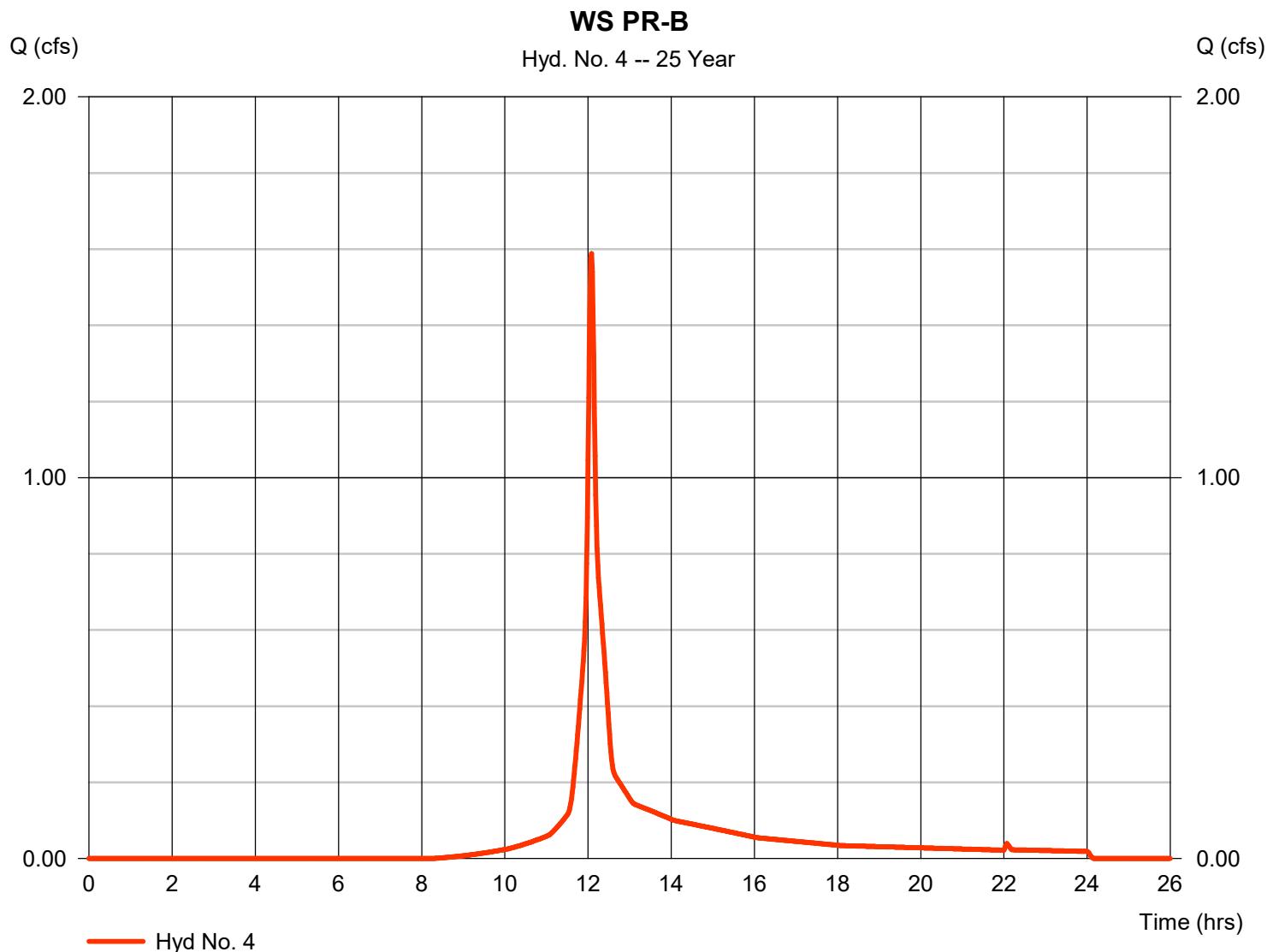
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 4

WS PR-B

Hydrograph type	= SCS Runoff	Peak discharge	= 1.589 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 4,894 cuft
Drainage area	= 0.380 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.54 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

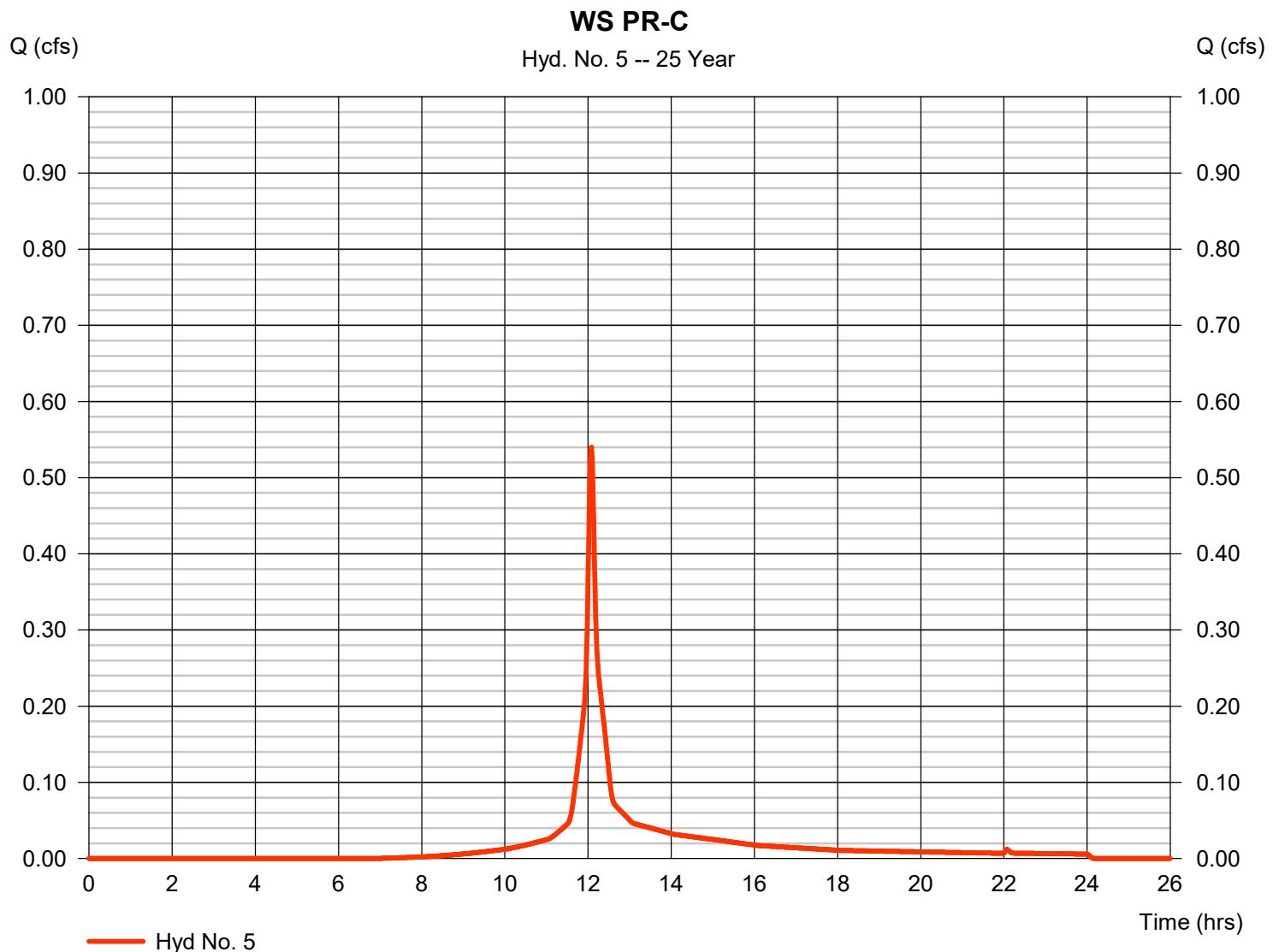
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 5

WS PR-C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.540 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,672 cuft
Drainage area	= 0.110 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.54 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

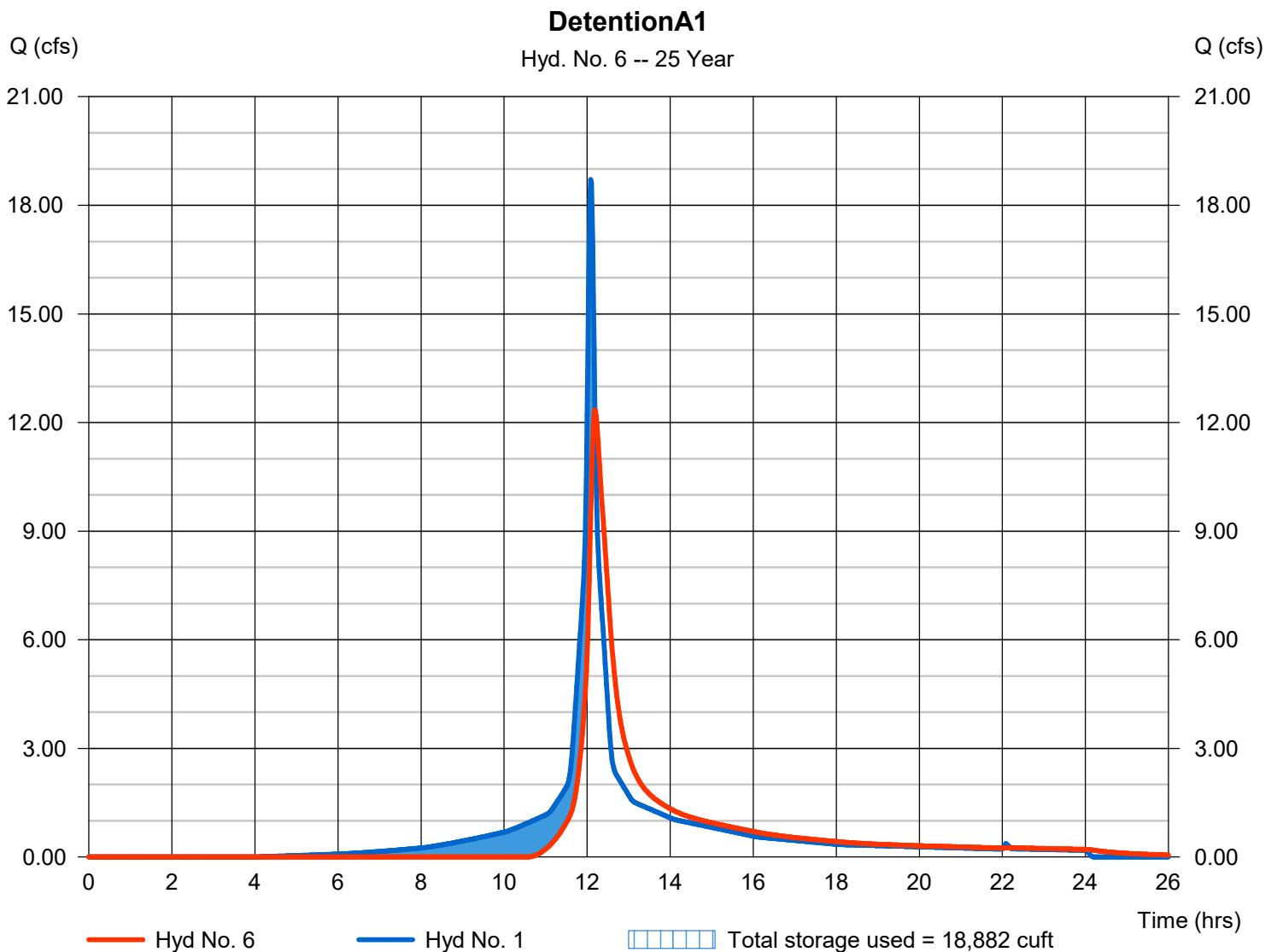
Wednesday, 12 / 26 / 2018

Hyd. No. 6

DetentionA1

Hydrograph type	= Reservoir	Peak discharge	= 12.35 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.18 hrs
Time interval	= 1 min	Hyd. volume	= 56,318 cuft
Inflow hyd. No.	= 1 - WS PR-A1	Max. Elevation	= 49.42 ft
Reservoir name	= Underground Detention A1	Max. Storage	= 18,882 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

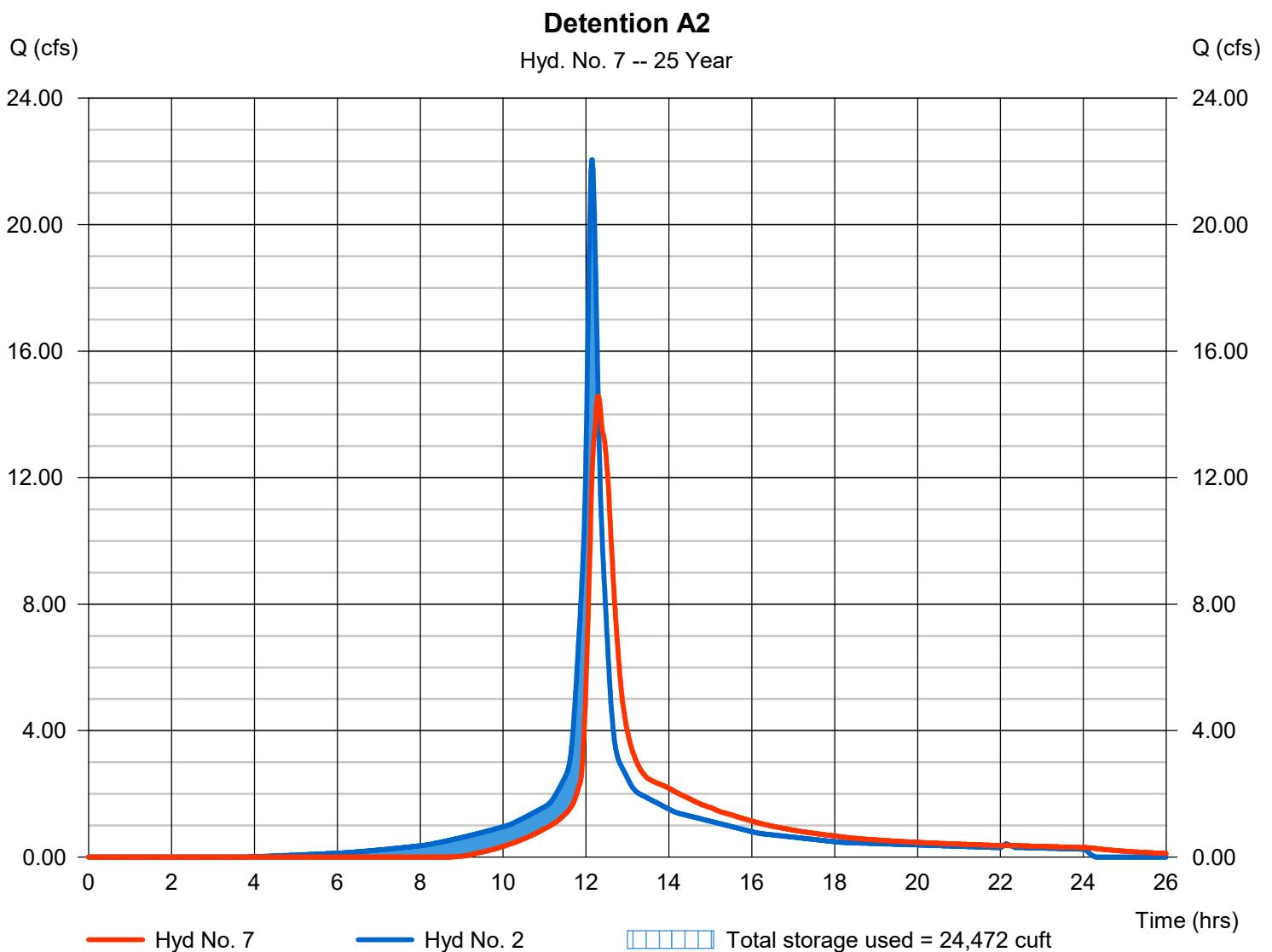
Wednesday, 12 / 26 / 2018

Hyd. No. 7

Detention A2

Hydrograph type	= Reservoir	Peak discharge	= 14.58 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.30 hrs
Time interval	= 1 min	Hyd. volume	= 83,554 cuft
Inflow hyd. No.	= 2 - WS PR-A2	Max. Elevation	= 47.74 ft
Reservoir name	= Underground Detention A2	Max. Storage	= 24,472 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

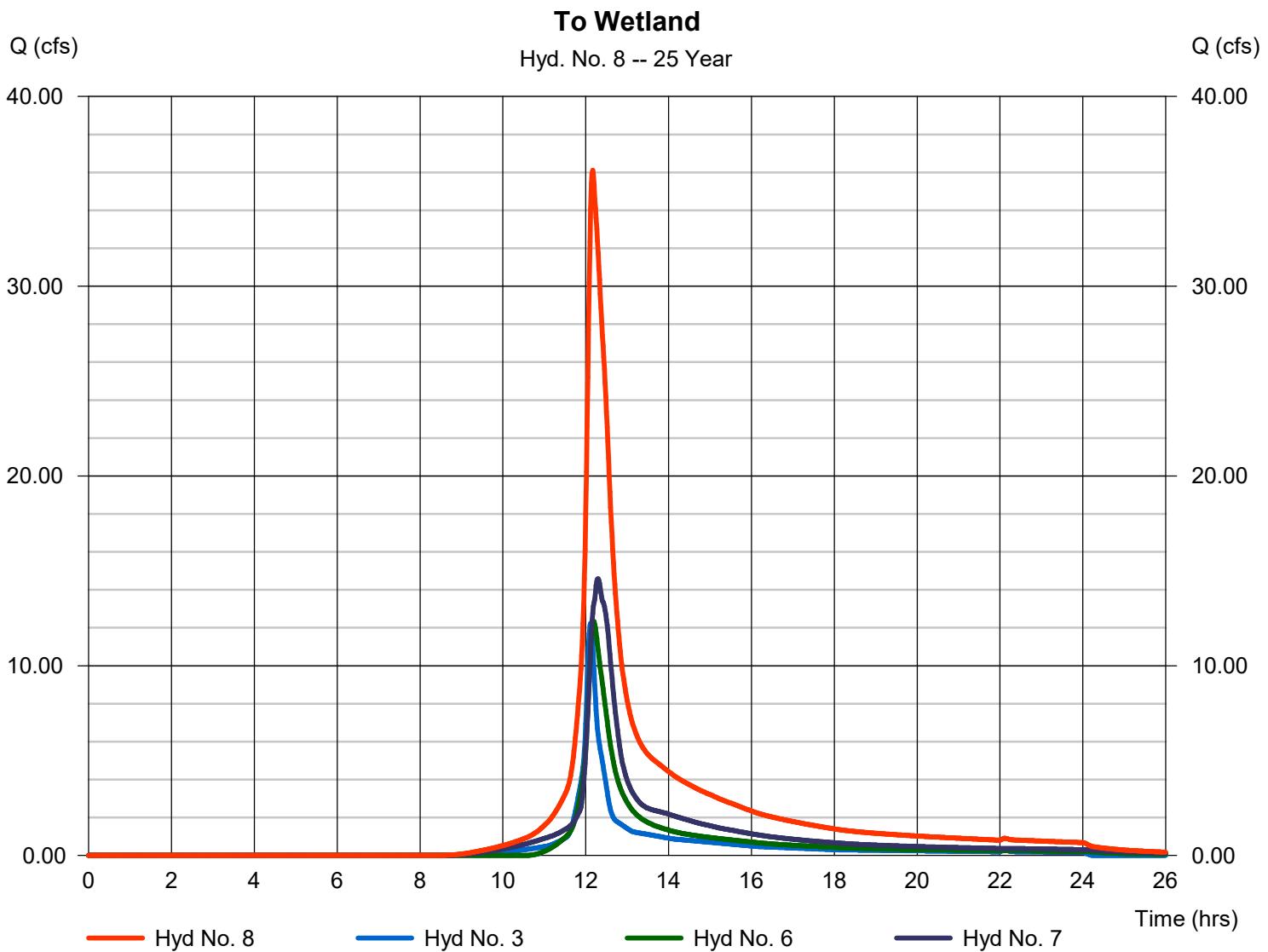
Wednesday, 12 / 26 / 2018

Hyd. No. 8

To Wetland

Hydrograph type = Combine
 Storm frequency = 25 yrs
 Time interval = 1 min
 Inflow hyds. = 3, 6, 7

Peak discharge = 36.12 cfs
 Time to peak = 12.17 hrs
 Hyd. volume = 181,817 cuft
 Contrib. drain. area = 3.460 ac



Hydrograph Report

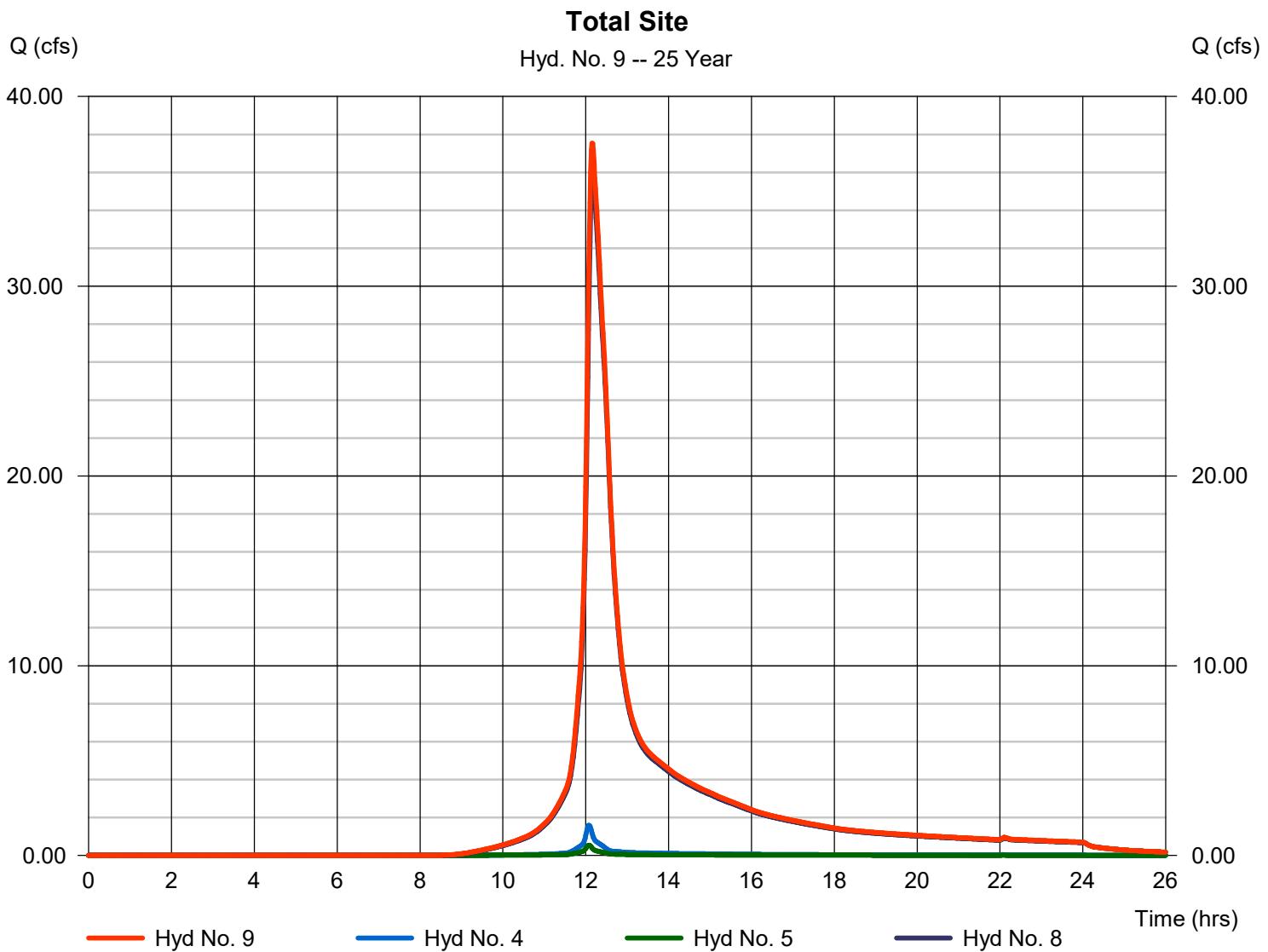
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 9

Total Site

Hydrograph type	= Combine	Peak discharge	= 37.53 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.15 hrs
Time interval	= 1 min	Hyd. volume	= 188,382 cuft
Inflow hyds.	= 4, 5, 8	Contrib. drain. area	= 0.490 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

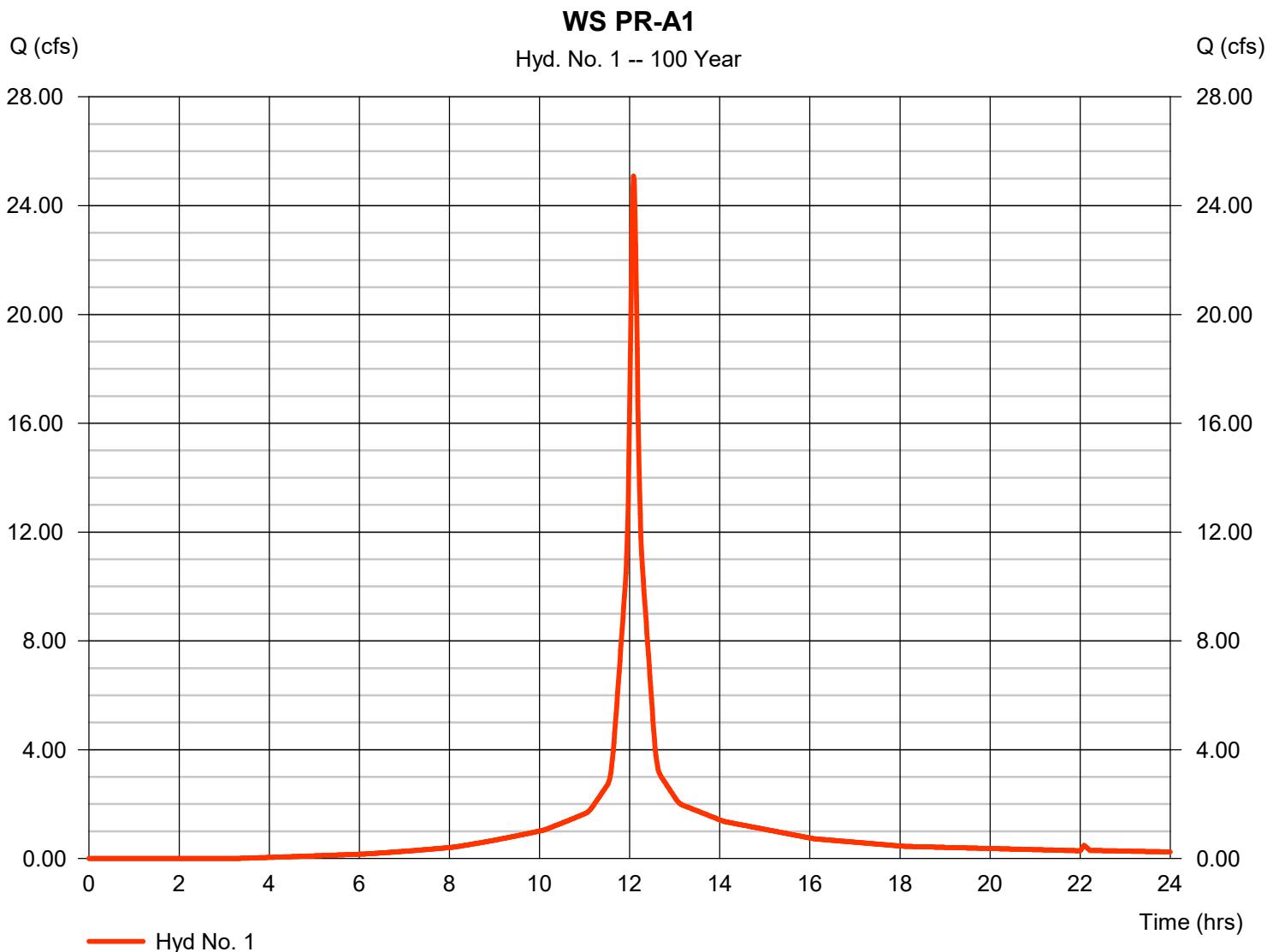
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	25.08	1	725	85,448	----	----	----	WS PR-A1
2	SCS Runoff	29.43	1	728	117,847	----	----	----	WS PR-A2
3	SCS Runoff	18.26	1	727	62,562	----	----	----	WS PR-A3
4	SCS Runoff	2.347	1	725	7,255	----	----	----	WS PR-B
5	SCS Runoff	0.765	1	724	2,396	----	----	----	WS PR-C
6	Reservoir	17.02	1	731	79,096	1	50.02	21,869	DetentionA1
7	Reservoir	20.70	1	737	114,566	2	48.47	28,758	Detention A2
8	Combine	51.54	1	730	256,225	3, 6, 7	----	----	To Wetland
9	Combine	53.57	1	730	265,875	4, 5, 8	----	----	Total Site
proposed.gpw				Return Period: 100 Year				Wednesday, 12 / 26 / 2018	

Hydrograph Report

Hyd. No. 1

WS PR-A1

Hydrograph type	= SCS Runoff	Peak discharge	= 25.08 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 85,448 cuft
Drainage area	= 3.440 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 8.00 min
Total precip.	= 8.46 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

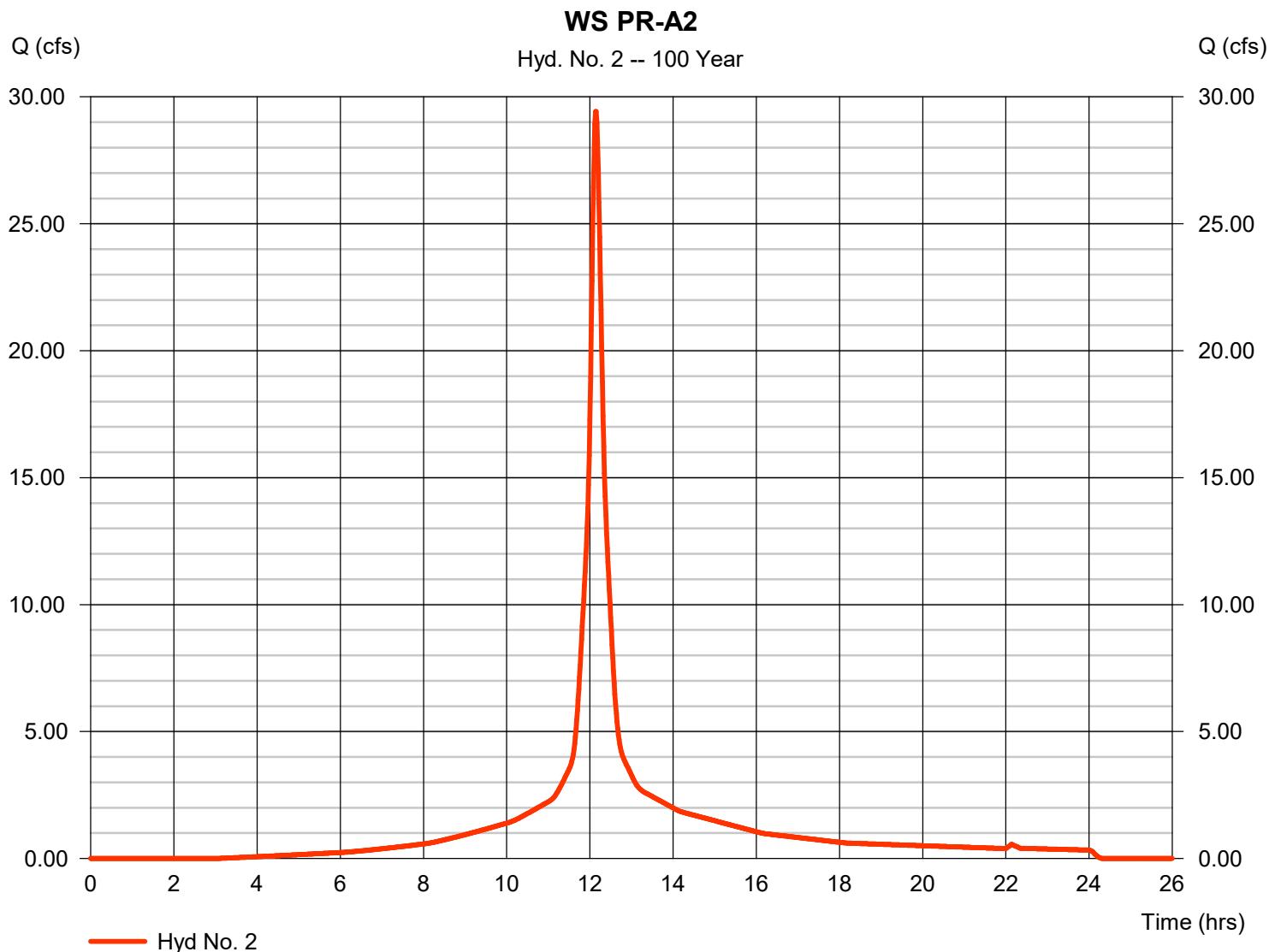
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 2

WS PR-A2

Hydrograph type	= SCS Runoff	Peak discharge	= 29.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 1 min	Hyd. volume	= 117,847 cuft
Drainage area	= 4.620 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.00 min
Total precip.	= 8.46 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

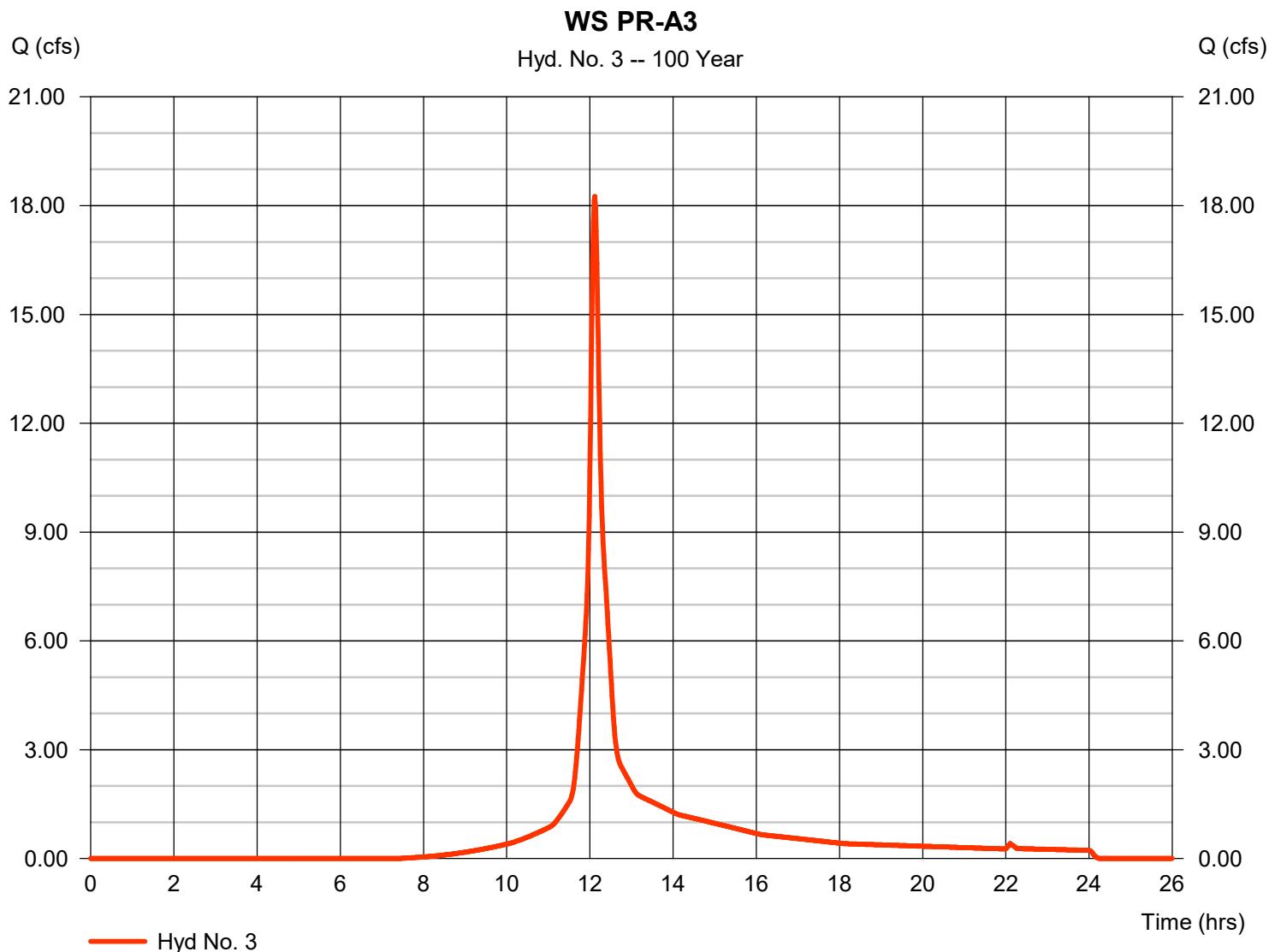
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 3

WS PR-A3

Hydrograph type	= SCS Runoff	Peak discharge	= 18.26 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.12 hrs
Time interval	= 1 min	Hyd. volume	= 62,562 cuft
Drainage area	= 3.460 ac	Curve number	= 71
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.46 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

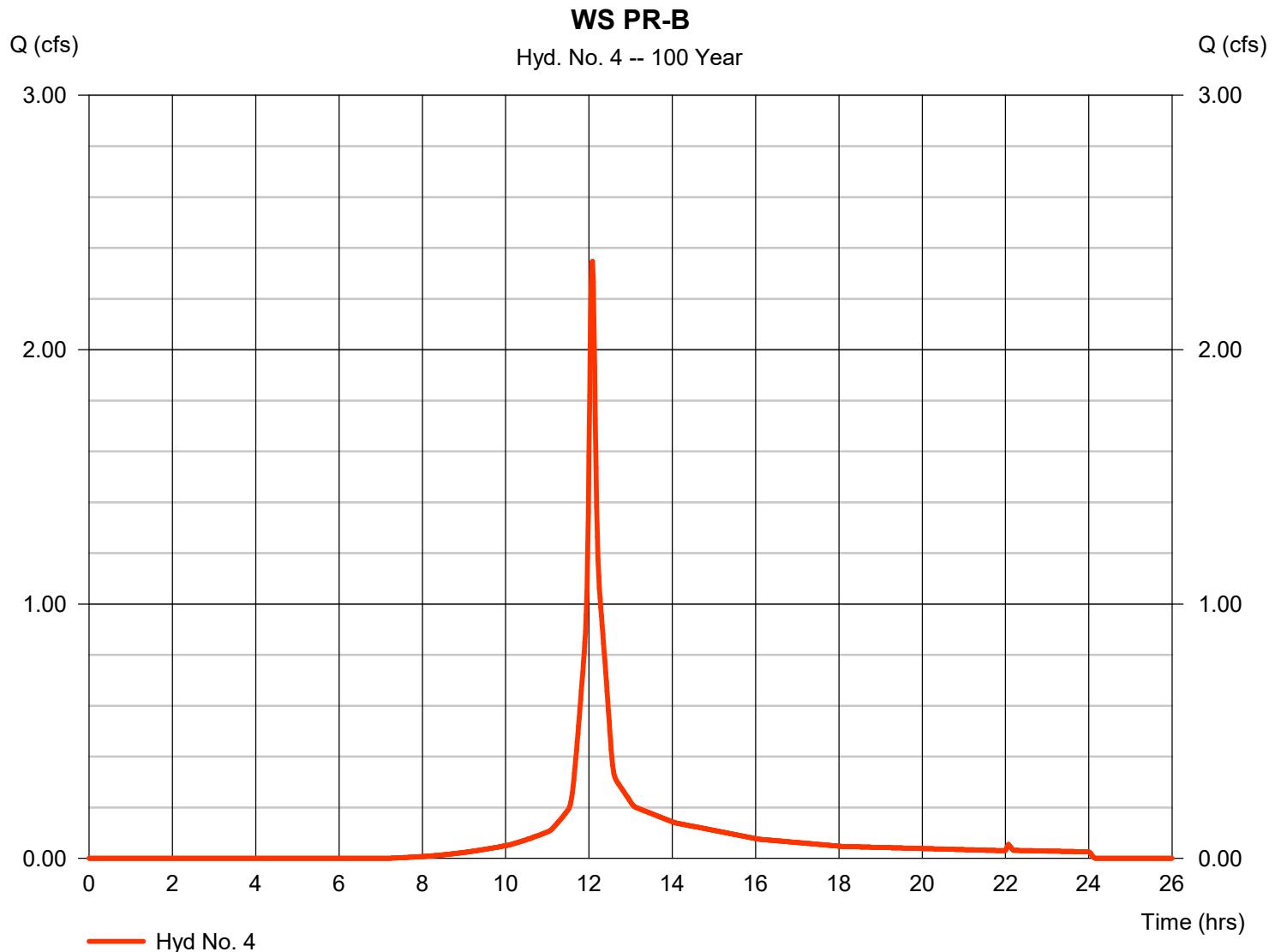
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 4

WS PR-B

Hydrograph type	= SCS Runoff	Peak discharge	= 2.347 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.08 hrs
Time interval	= 1 min	Hyd. volume	= 7,255 cuft
Drainage area	= 0.380 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 8.46 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

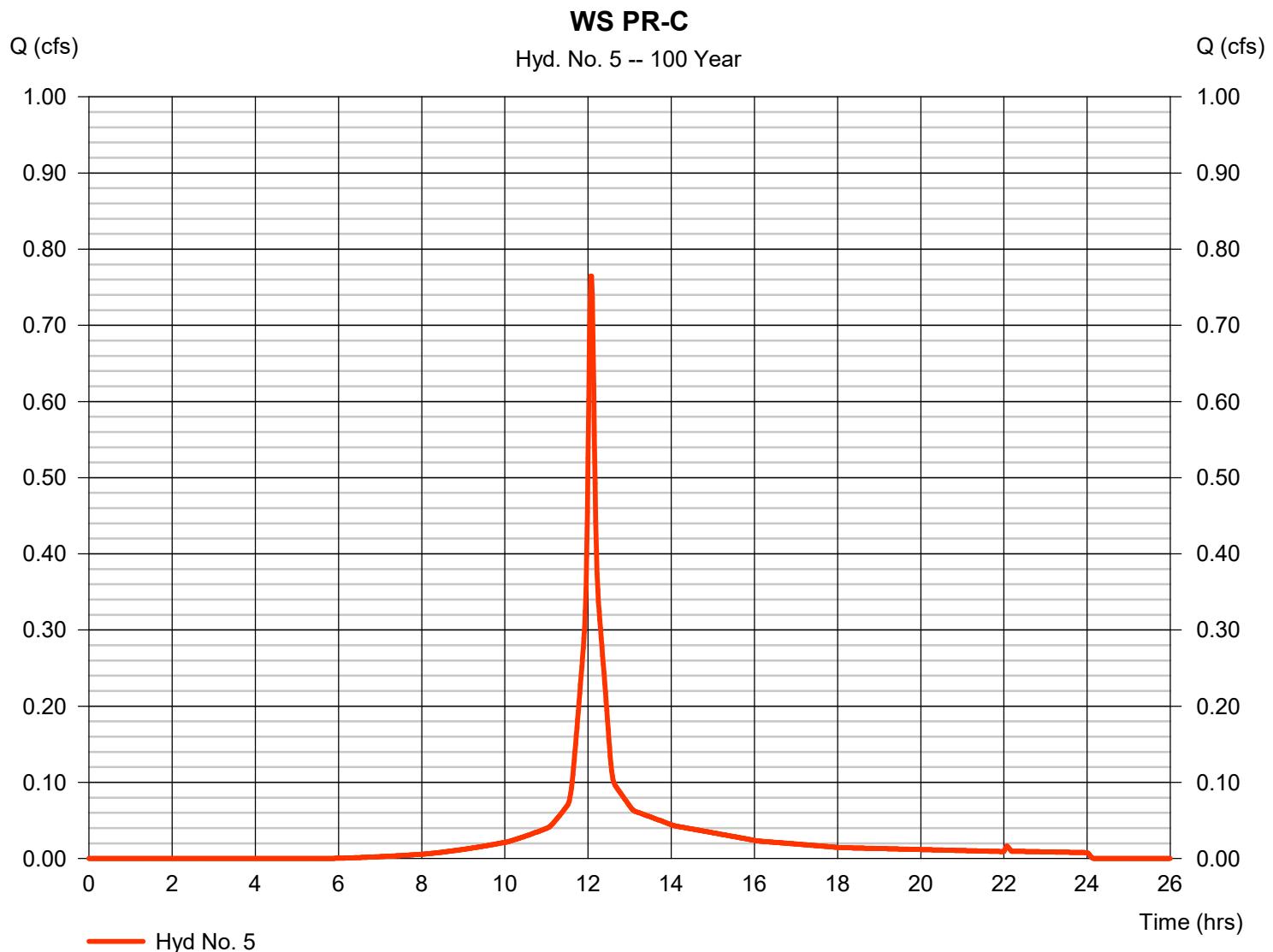
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 5

WS PR-C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.765 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 1 min	Hyd. volume	= 2,396 cuft
Drainage area	= 0.110 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.46 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

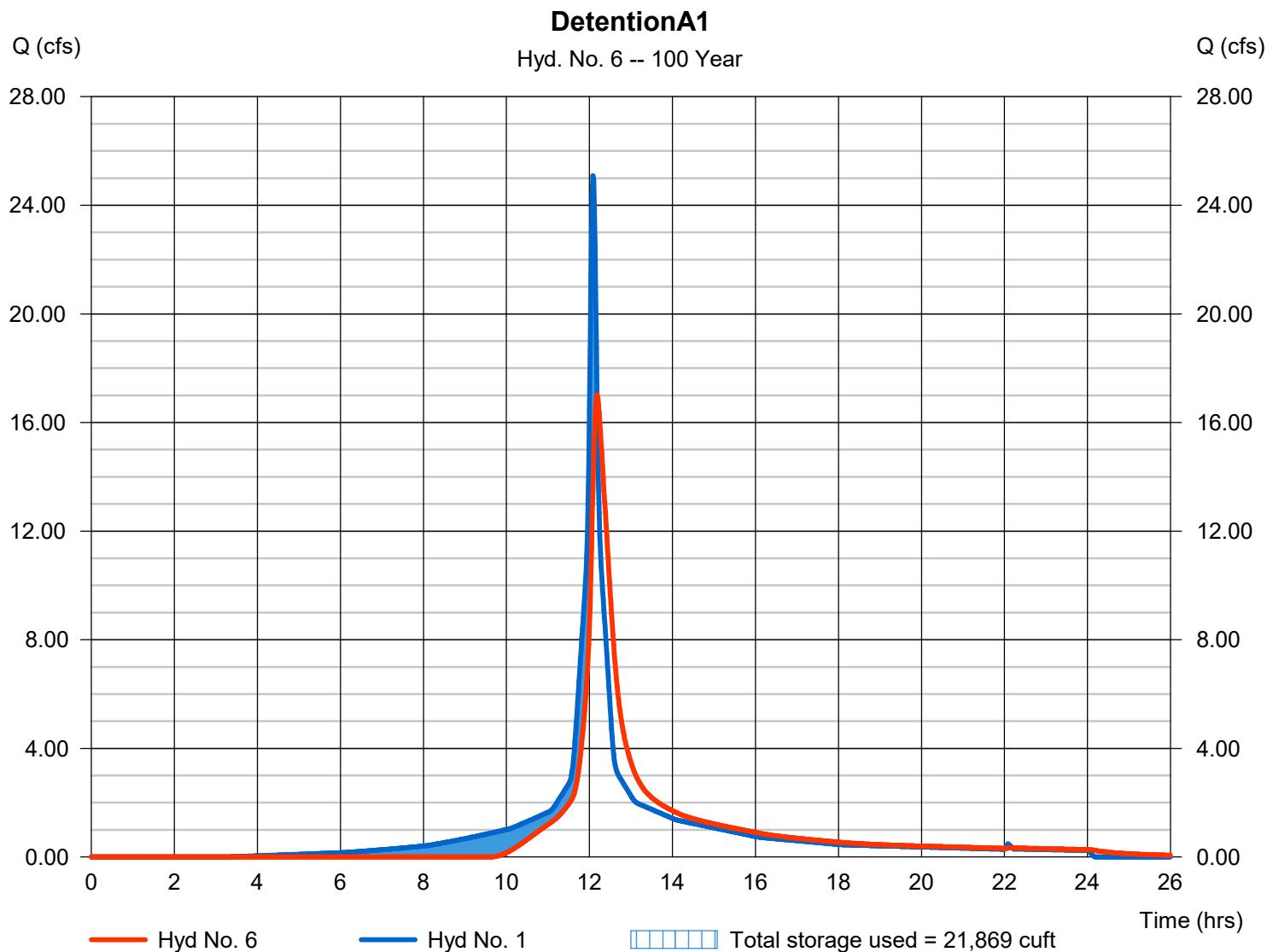
Wednesday, 12 / 26 / 2018

Hyd. No. 6

DetentionA1

Hydrograph type	= Reservoir	Peak discharge	= 17.02 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.18 hrs
Time interval	= 1 min	Hyd. volume	= 79,096 cuft
Inflow hyd. No.	= 1 - WS PR-A1	Max. Elevation	= 50.02 ft
Reservoir name	= Underground Detention A1	Max. Storage	= 21,869 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

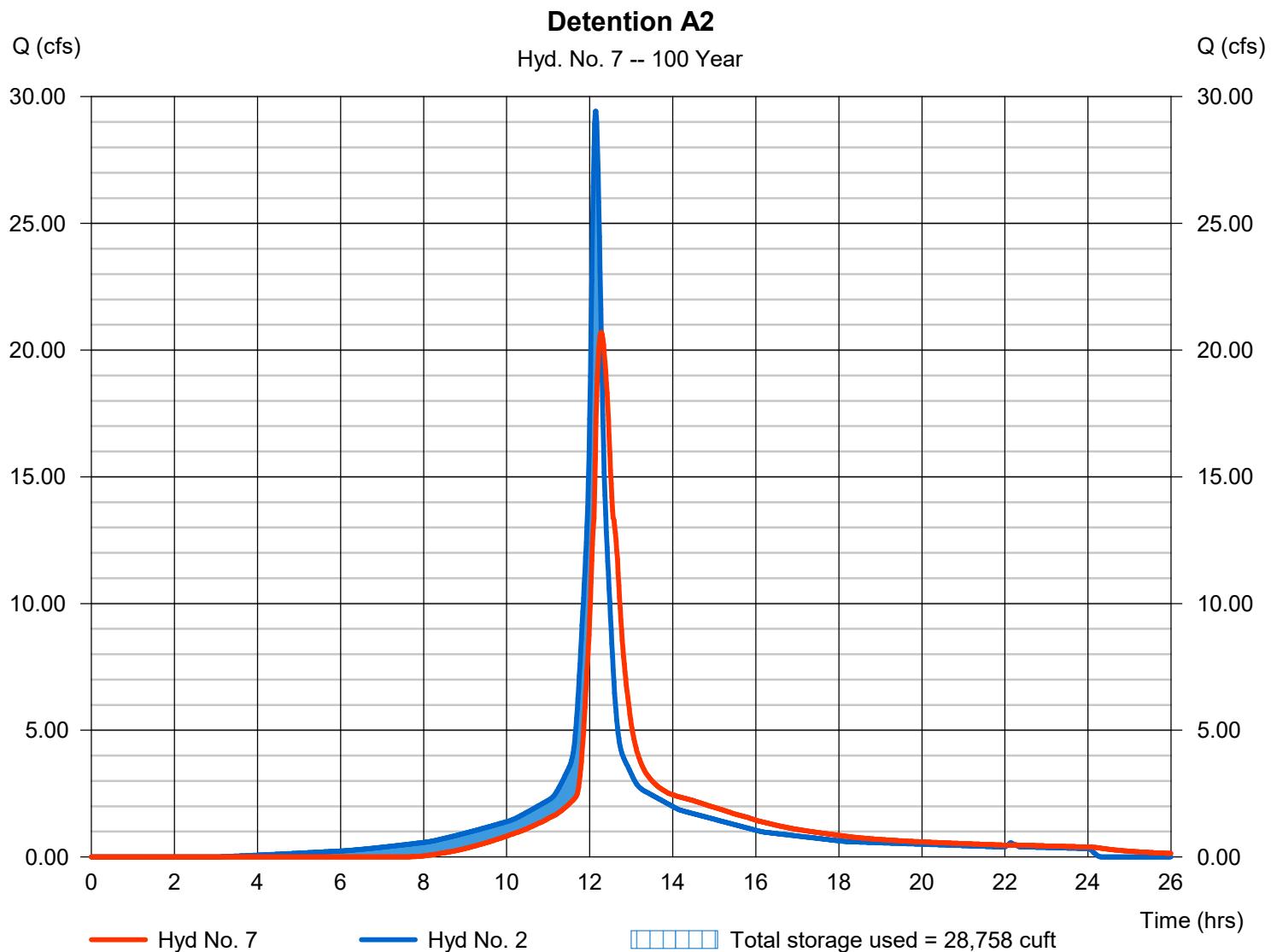
Wednesday, 12 / 26 / 2018

Hyd. No. 7

Detention A2

Hydrograph type	= Reservoir	Peak discharge	= 20.70 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.28 hrs
Time interval	= 1 min	Hyd. volume	= 114,566 cuft
Inflow hyd. No.	= 2 - WS PR-A2	Max. Elevation	= 48.47 ft
Reservoir name	= Underground Detention A2	Max. Storage	= 28,758 cuft

Storage Indication method used.



Hydrograph Report

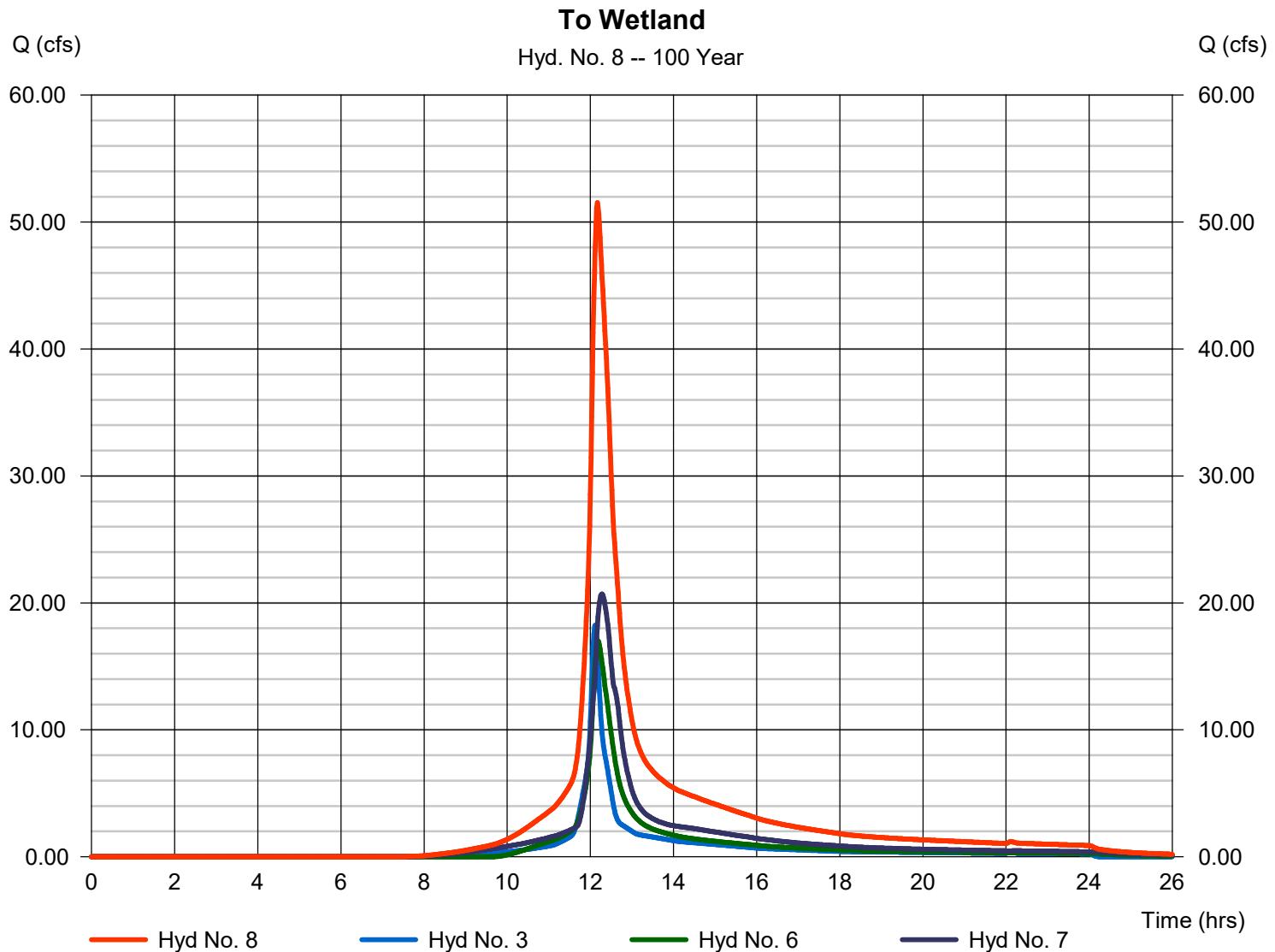
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 8

To Wetland

Hydrograph type	= Combine	Peak discharge	= 51.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 1 min	Hyd. volume	= 256,225 cuft
Inflow hyds.	= 3, 6, 7	Contrib. drain. area	= 3.460 ac



Hydrograph Report

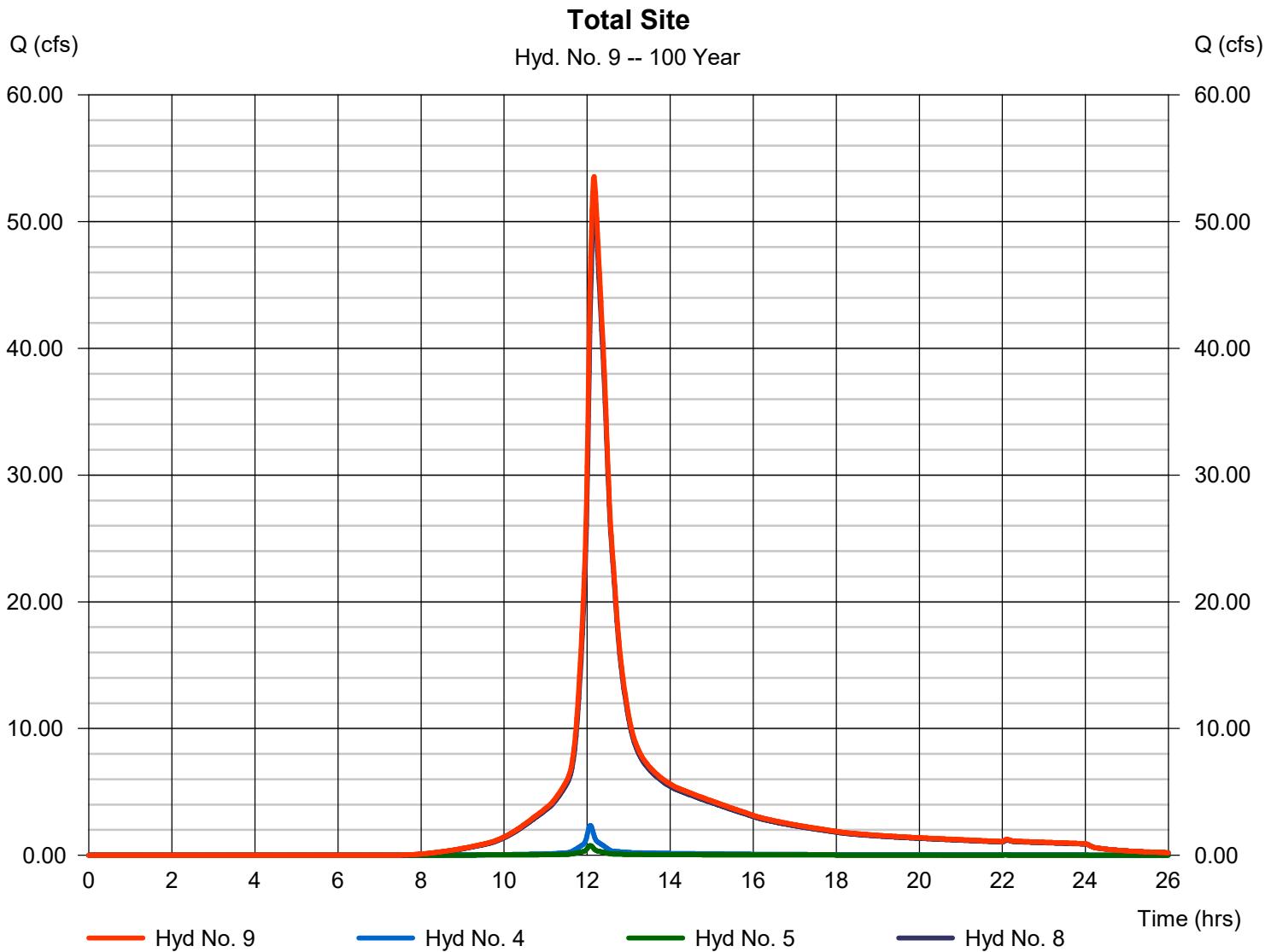
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 12 / 26 / 2018

Hyd. No. 9

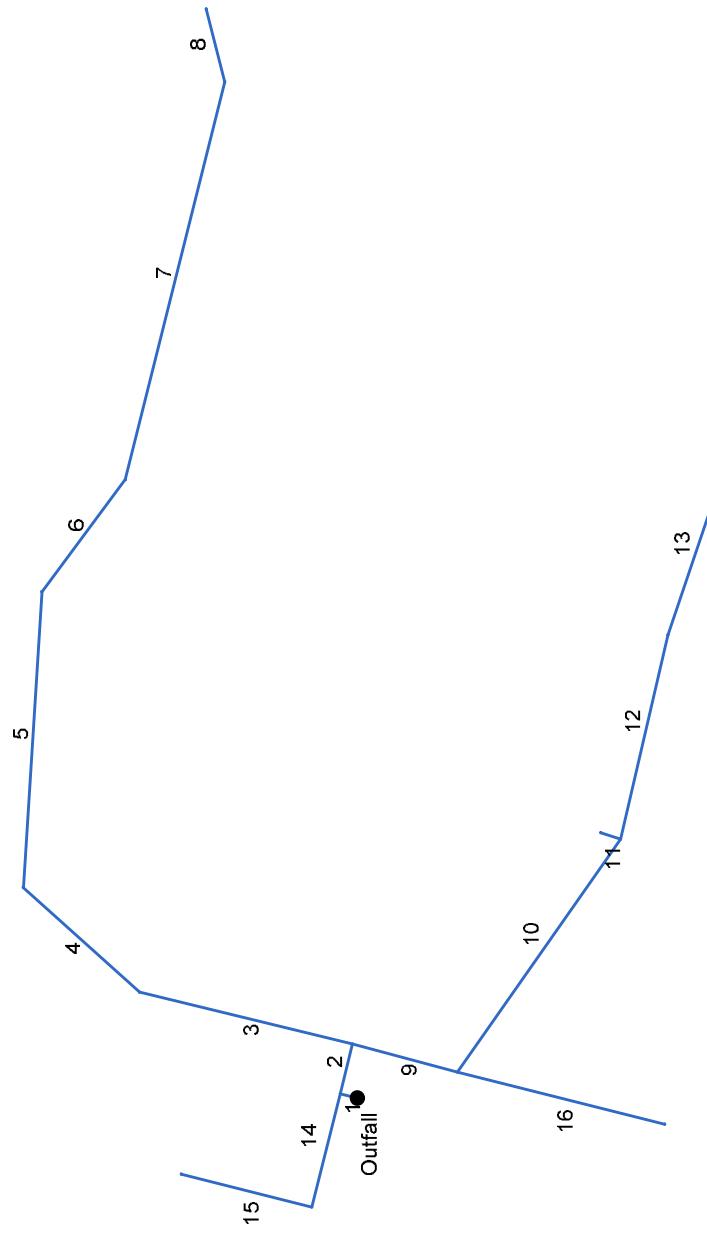
Total Site

Hydrograph type	= Combine	Peak discharge	= 53.57 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 1 min	Hyd. volume	= 265,875 cuft
Inflow hyds.	= 4, 5, 8	Contrib. drain. area	= 0.490 ac



APPENDIX C
Stormwater Collection System Calculations

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Proposed North.strm

Number of lines: 16

Date: 12/6/2018

Storm Sewer Inventory Report

Line No.	Alignment			Flow Data				Physical Data				Line ID					
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drg Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Line Size (in)	N Value (n)	J-Loss Coeff (K)	Inlet Rim El (ft)			
1	End	8.372	-76.281	MH	0.00	0.00	0.00	0.0	47.25	0.00	47.25	18	Cir	0.012	1.00	58.31	OCS202-MH203
2	1	24.237	90.372	MH	0.00	0.00	0.00	0.0	51.52	1.98	52.00	18	Cir	0.012	1.00	62.91	MH203-MH206
3	2	104.046	-90.449	Genr	0.00	0.11	0.82	5.0	55.70	1.97	57.75	18	Cir	0.012	0.79	62.84	MH206-CCB207
4	3	74.061	28.221	Genr	0.00	0.48	0.82	5.0	57.75	1.00	58.49	18	Cir	0.012	1.23	63.12	CCB207-CCB208
5	4	140.277	51.754	Genr	0.00	0.31	0.88	5.0	58.49	0.50	59.19	15	Cir	0.012	0.90	63.19	CCB208-CCB209
6	5	66.188	33.063	Genr	0.00	0.35	0.88	5.0	59.19	4.53	62.19	15	Cir	0.012	0.66	68.28	CCB209-CCB210
7	6	193.939	-22.593	Genr	0.00	0.40	0.83	5.0	62.19	1.45	65.00	15	Cir	0.012	0.80	69.00	CCB210-CCB211
8	7	35.650	-28.469	Genr	0.00	0.22	0.76	5.0	65.00	1.40	65.50	15	Cir	0.012	1.00	69.05	CCB211-CCB212
9	2	51.547	90.850	Genr	0.00	0.18	0.83	5.0	52.00	1.94	53.00	15	Cir	0.012	1.43	61.69	MH206-CCB213
10	9	134.701	-69.896	Genr	0.00	0.02	0.54	5.0	53.00	0.74	54.00	15	Cir	0.012	2.17	61.99	CCB213-YD215
11	10	9.877	-107.235	Genr	0.00	0.21	0.58	5.0	59.00	6.38	59.63	8	Cir	0.012	1.00	62.03	YD215-TRENCHDRAIN
12	10	99.081	-21.932	Genr	0.00	0.25	0.37	5.0	54.00	1.01	55.00	12	Cir	0.012	0.50	61.02	YD215-YD216
13	12	74.353	5.567	Genr	0.00	0.31	0.90	5.0	55.00	1.00	55.74	12	Cir	0.012	1.00	58.50	YD216-YD217
14	1	55.320	-89.638	Genr	0.00	0.15	0.77	5.0	51.80	2.17	53.00	15	Cir	0.012	1.50	56.84	MH203-CCB204
15	14	63.909	89.982	Genr	0.00	0.16	0.89	5.0	53.00	4.54	55.90	15	Cir	0.012	1.00	58.46	CCB204-CCB205
16	9	101.392	-0.859	Genr	0.00	0.22	0.85	5.0	53.00	1.97	55.00	8	Cir	0.012	1.00	58.89	CCB213-CCB214
													Number of lines: 16	Date: 12/6/2018			

Structure Report

Page 1

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	MH-203	Manhole	58.31	Cir	0.00	0.00	18	Cir	47.25	18	Cir	51.52
2	MH-206	Manhole	62.91	Cir	0.00	0.00	18	Cir	52.00	18	Cir	51.80
3	CCB-207	Generic	62.84	Cir	0.00	0.00	18	Cir	57.75	18	Cir	55.70
4	CCB-208	Generic	63.12	Cir	0.00	0.00	18	Cir	58.49	15	Cir	52.00
5	CCB-209	Generic	63.19	Cir	0.00	0.00	15	Cir	59.19	15	Cir	57.75
6	CCB-210	Generic	68.28	Cir	0.00	0.00	15	Cir	62.19	15	Cir	58.49
7	CCB-211	Generic	69.00	Cir	0.00	0.00	15	Cir	65.00	15	Cir	59.19
8	CCB-212	Generic	69.05	Cir	0.00	0.00	15	Cir	65.50			62.19
9	CCB-213	Generic	61.69	Cir	0.00	0.00	15	Cir	53.00	15	Cir	65.00
10	YD-215	Generic	61.99	Cir	0.00	0.00	15	Cir	54.00	8	Cir	53.00
11	TRENCH DRAIN			Cir	0.00	0.00	8	Cir	59.63			53.00
12	YD-216	Generic	62.03	Cir	0.00	0.00	12	Cir	55.00	12	Cir	54.00
13	YD-217	Generic	61.02	Cir	0.00	0.00	12	Cir	55.74			55.00
14	CCB-204	Generic	58.50	Cir	0.00	0.00	12	Cir	53.00	15	Cir	53.00
15	CCB-205	Generic	56.84	Cir	0.00	0.00	15	Cir	55.90			
16	CCB-214	Generic	58.46	Cir	0.00	0.00	15	Cir	55.00			
			58.89	Cir	0.00	0.00	8	Cir				
										Number of Structures: 16		Run Date: 12/6/2018

Storm Sewer Summary Report

Page 1

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	OCS202-MH203	17.78	18	Cir	8.372	47.25	47.25	0.000	49.09*	49.30*	1.57	50.87	End	Manhole
2	MH203-MH206	16.08	18	Cir	24.237	51.52	52.00	1.980	52.76	53.43	n/a	53.43	1	Manhole
3	MH206-CCB207	10.54	18	Cir	104.046	55.70	57.75	1.970	56.59	59.00	n/a	59.00	2	Generic
4	CCB207-CCB208	10.00	18	Cir	74.061	57.75	58.49	0.999	59.00	59.71	n/a	59.71 j	3	Generic
5	CCB208-CCB209	7.44	15	Cir	140.277	58.49	59.19	0.499	59.74*	61.33*	0.51	61.84	4	Generic
6	CCB209-CCB210	5.61	15	Cir	66.188	59.19	62.19	4.533	61.84	63.15	n/a	63.15 j	5	Generic
7	CCB210-CCB211	3.58	15	Cir	193.939	62.19	65.00	1.449	63.15	65.76	n/a	65.76 j	6	Generic
8	CCB211-CCB212	1.21	15	Cir	35.650	65.00	65.50	1.403	65.76	65.93	n/a	65.93 j	7	Generic
9	MH206-CCB213	5.79	15	Cir	51.547	52.00	53.00	1.940	53.43	53.97	n/a	53.97 j	2	Generic
10	CCB213-YD215	3.55	15	Cir	134.701	53.00	54.00	0.742	53.97	54.76	n/a	54.76 j	9	Generic
11	YD215-TRENCHDRAIN	0.88	8	Cir	9.877	59.00	59.63	6.378	59.24	60.07	0.20	60.07	10	Generic
12	YD215-YD216	2.65	12	Cir	99.081	54.00	55.00	1.009	54.76	55.70	n/a	55.70 j	10	Generic
13	YD216-YD217	2.02	12	Cir	74.353	55.00	55.74	0.995	55.70	56.35	n/a	56.35 j	12	Generic
14	MH203-CCB204	1.84	15	Cir	55.320	51.80	53.00	2.169	52.16	53.54	n/a	53.54	1	Generic
15	CCB204-CCB205	1.03	15	Cir	63.909	53.00	55.90	4.538	53.54	56.30	n/a	56.30 j	14	Generic
16	CCB213-CCB214	1.35	8	Cir	101.392	53.00	55.00	1.973	53.97	55.55	n/a	55.55 j	9	Generic
													Number of lines: 16	Run Date: 12/6/2018

Project File: Proposed North strn

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station	Len	Drng Area		Area x C		Tc		Rain (I)		Total flow	Cap full	Vel	Pipe	Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID		
		Incr	Total	Incr	Total	Inlet	Syst	(min)	(in/hr)					(ft/s)	(in)	Slope (%)	Dn	Up	(ft)	(ft)		
1	End	8.372	0.00	3.37	0.00	0.00	2.66	0.0	7.1	6.7	17.78	0.00	10.06	18	0.00	47.25	47.25	49.09	49.30	58.08	58.31	OCS202-MH203
2	1	24.237	0.00	3.06	0.00	0.00	2.40	0.0	7.1	6.7	16.08	16.01	9.80	18	1.98	51.52	52.00	52.76	53.43	58.31	62.91	MH203-MH206
3	2	104.046	0.11	1.87	0.82	0.09	1.56	5.0	6.8	6.7	10.54	15.97	8.18	18	1.97	55.70	57.75	56.59	59.00	62.91	62.84	MH206-CCB207
4	3	74.061	0.48	1.76	0.82	0.39	1.47	5.0	6.7	6.8	10.00	11.37	6.44	18	1.00	57.75	58.49	59.00	59.71	62.84	63.12	CCB207-CCB208
5	4	140.277	0.31	1.28	0.88	0.27	1.08	5.0	6.3	6.9	7.44	4.94	6.06	15	0.50	58.49	59.19	59.74	61.33	63.12	63.19	CCB208-CCB209
6	5	66.188	0.35	0.97	0.88	0.31	0.81	5.0	6.0	6.9	5.61	14.89	5.06	15	4.53	59.19	62.19	61.84	63.15	63.19	68.28	CCB209-CCB210
7	6	193.939	0.40	0.62	0.83	0.33	0.50	5.0	5.3	7.2	3.58	8.42	4.05	15	1.45	62.19	65.00	63.15	65.76	68.28	69.00	CCB210-CCB211
8	7	35.650	0.22	0.22	0.76	0.17	0.17	5.0	5.0	7.2	1.21	8.28	2.37	15	1.40	65.00	65.50	65.76	65.93	69.00	69.05	CCB211-CCB212
9	2	51.547	0.18	1.19	0.83	0.15	0.84	5.0	6.3	6.9	5.79	9.74	5.18	15	1.94	52.00	53.00	53.43	53.97	62.91	61.69	MH206-CCB213
10	9	134.701	0.02	0.79	0.54	0.01	0.50	5.0	5.7	7.0	3.55	6.03	4.00	15	0.74	53.00	54.00	53.97	54.76	61.69	61.99	CCB213-YD215
11	10	9.877	0.21	0.21	0.58	0.12	0.12	5.0	5.0	7.2	0.88	3.30	5.79	8	6.38	59.00	59.63	59.24	60.07	61.99	62.03	YD215-TRENCH
12	10	99.081	0.25	0.56	0.37	0.09	0.37	5.0	5.3	7.1	2.65	3.88	4.34	12	1.01	54.00	55.00	54.76	55.70	61.99	61.02	YD215-YD216
13	12	74.353	0.31	0.31	0.90	0.28	0.28	5.0	5.0	7.2	2.02	3.85	3.75	12	1.00	55.00	55.74	55.70	56.35	61.02	58.50	YD216-YD217
14	1	55.320	0.15	0.31	0.77	0.12	0.26	5.0	5.4	7.1	1.84	10.30	4.98	15	2.17	51.80	53.00	52.16	53.54	58.31	56.84	MH203-CCB204
15	14	63.909	0.16	0.16	0.89	0.14	0.14	5.0	5.0	7.2	1.03	14.90	2.55	15	4.54	53.00	55.90	53.54	56.30	56.84	58.46	CCB204-CCB205
16	9	101.392	0.22	0.22	0.85	0.19	0.19	5.0	5.0	7.2	1.35	1.84	4.14	8	1.97	53.00	55.00	53.97	55.55	61.69	58.89	CCB213-CCB214
																			Number of lines: 16		Run Date: 12/6/2018	

Project File: Proposed North.stm

NOTES:Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period = Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Inlet Time Tabulation

Line No.	Line ID	Tc	Sheet Flow			Shallow Concentrated Flow			Channel Flow			Total Travel Time (min)	
			Method	n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	Ave Surf Descr	Water Slope (%)	X-sec Area (sqft)	Wetted Perim (ft)	
1	OCS202-MH203	User											0.00
2	MH203-MH206	User											0.00
3	MH206-CCB207	User											5.00
4	CCB207-CCB208	User											5.00
5	CCB208-CCB209	User											5.00
6	CCB209-CCB210	User											5.00
7	CCB210-CCB211	User											5.00
8	CCB211-CCB212	User											5.00
9	MH206-CCB213	User											5.00
10	CCB213-YD215	User											5.00
11	YD215-TRENCHDRAIN	User											5.00
12	YD215-YD216	User											5.00
13	YD216-YD217	User											5.00
14	MH203-CCB204	User											5.00
15	CCB204-CCB205	User											5.00
16	CCB213-CCB214	User											5.00

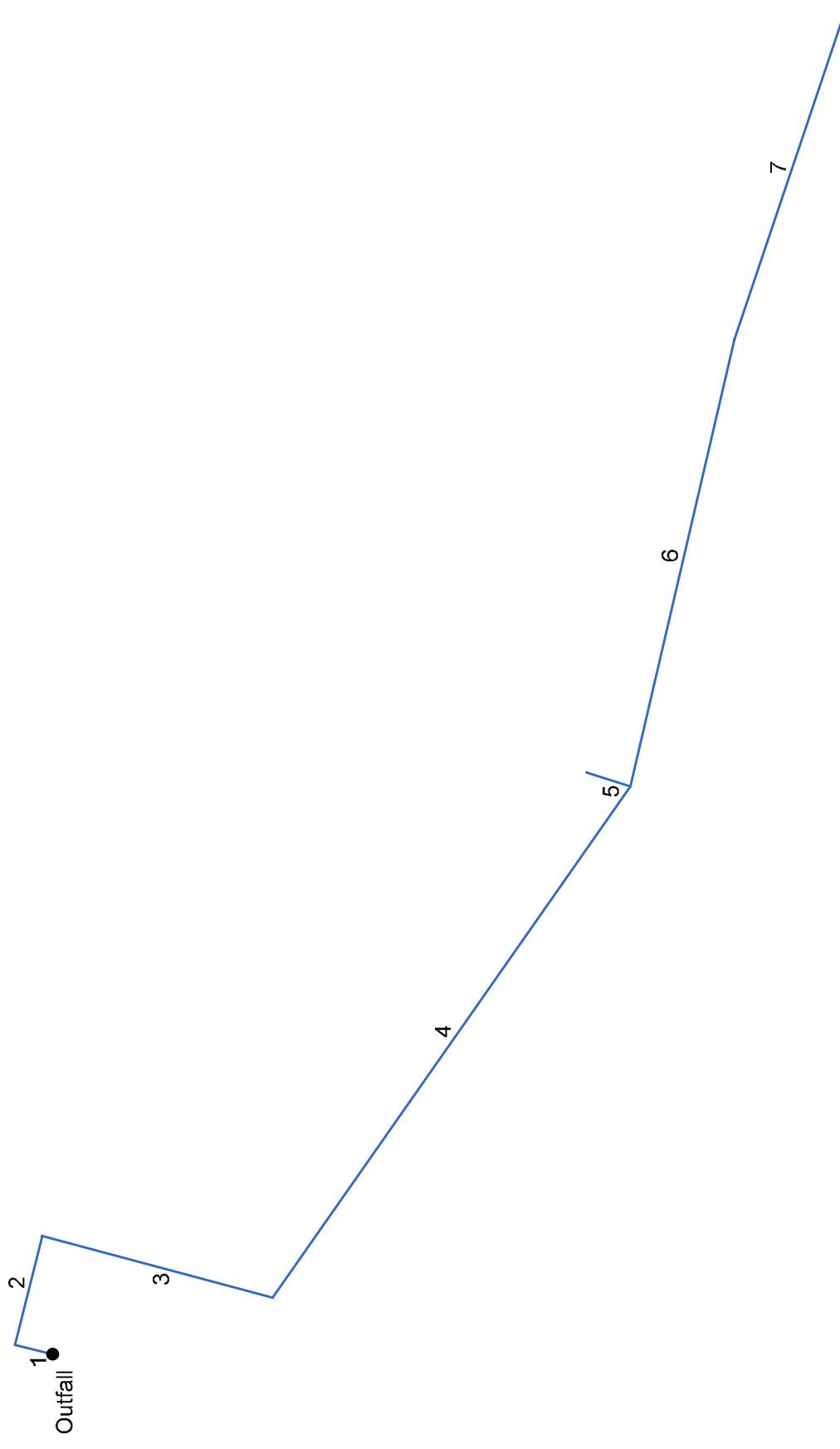
Project File: Proposed North.stm

Min. Tc used for intensity calculations = 5 min

Number of lines: 16

Date: 12/6/2018

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 100yr Yard Drain.stm

Number of lines: 7

Date: 12/6/2018

Storm Sewer Inventory Report

Line No.	Alignment			Flow Data			Physical Data				Line ID						
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drg Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Line Size (in)	N Value (n)	J-Loss Coeff (K)	Inlet Rim El (ft)			
1	End	8.372	-76.281	MH	0.00	0.00	0.00	0.0	47.25	0.00	18	Cir	0.012	1.00	58.31	OCS202-MH203	
2	1	24.237	90.372	MH	0.00	0.00	0.00	0.0	51.52	1.98	52.00	18	Cir	0.012	1.00	62.91	MH203-MH206
3	2	51.547	90.850	Genr	0.00	0.18	0.83	5.0	52.00	1.94	53.00	15	Cir	0.012	1.43	61.69	MH206-CCB213
4	3	134.701	-69.896	Genr	0.00	0.02	0.54	5.0	53.00	0.74	54.00	15	Cir	0.012	1.50	61.99	CCB213-YD215
5	4	9.877	-107.235	Genr	0.00	0.21	0.58	5.0	59.00	6.38	59.63	8	Cir	0.012	1.00	62.03	YD215-TRENCHDRAIN
6	4	99.081	-21.932	Genr	0.00	0.25	0.37	5.0	54.00	1.01	55.00	12	Cir	0.012	0.50	61.02	YD215-YD216
7	6	74.353	5.567	Genr	0.00	0.31	0.90	5.0	55.00	1.00	55.74	12	Cir	0.012	1.00	58.50	YD216-YD217
													Number of lines: 7		Date: 12/6/2018		
															Storm Sewers v12.00		

Structure Report

Page 1

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	MH-203	Manhole	58.31	Cir	0.00	0.00	18	Cir	47.25	18	Cir	51.52
2	MH-206	Manhole	62.91	Cir	0.00	0.00	18	Cir	52.00	15	Cir	52.00
3	CCB-213	Generic	61.69	Cir	0.00	0.00	15	Cir	53.00	15	Cir	53.00
4	YD-215	Generic	61.99	Cir	0.00	0.00	15	Cir	54.00	8	Cir	59.00
5	TRENCH DRAIN	Generic	62.03	Cir	0.00	0.00	8	Cir	59.63	12	Cir	54.00
6	YD-216	Generic	61.02	Cir	0.00	0.00	12	Cir	55.00	12	Cir	55.00
7	YD-217	Generic	58.50	Cir	0.00	0.00	12	Cir	55.74			

Project File: 100yr Yard Drain.stm

Number of Structures: 7

Run Date: 12/6/2018

Storm Sewer Summary Report

Page 1

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	OCS202-MH203	6.15	18	Cir	8.372	47.25	47.25	0.000	50.02*	50.04*	0.19	50.23	End	Manhole
2	MH203-MH206	6.16	18	Cir	24.237	51.52	52.00	1.980	52.17	52.96	0.42	52.96	1	Manhole
3	MH206-CCB213	6.19	15	Cir	51.547	52.00	53.00	1.940	52.96	54.00	0.76	54.00	2	Generic
4	CCB213-YD215	4.85	15	Cir	134.701	53.00	54.00	0.742	54.00	54.89	n/a	54.89 j	3	Generic
5	YD215-TRENCHDRAIN	1.20	8	Cir	9.877	59.00	59.63	6.378	59.28	60.15	0.26	60.15	4	Generic
6	YD215-YD216	3.62	12	Cir	99.081	54.00	55.00	1.009	54.89	55.81	n/a	55.81 j	4	Generic
7	YD216-YD217	2.74	12	Cir	74.353	55.00	55.74	0.995	55.81	56.45	n/a	56.45 j	6	Generic
													Number of lines: 7	Run Date: 12/6/2018
													Project File: 100yr Yard Drain.stm	
NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.													Storm Sewers v12.00	

Storm Sewer Tabulation

Page 1

Station	Len	Drgn Area	Rnoff coeff		Area x C		Tc	Rain (I)	Total flow	Cap full	Vel	Pipe	Invert Elev		HGL Elev		Gnd / Rim Elev	Line ID		
Line	To Line	Incr	Total	Incr	Total	Inlet	Syst	(min)	(cfs)	(cfs)	(ft/s)	Size	Slope (%)	Dn	Up	Dn	Up	(ft)	(ft)	
1	End	8.372	0.00	0.97	0.00	0.00	0.65	0.0	6.3	9.4	6.15	0.00	3.48	18	0.00	47.25	47.25	50.02	50.04	OCS202-MH203
2	1	24.237	0.00	0.97	0.00	0.00	0.65	0.0	6.2	9.4	6.16	16.01	6.81	18	1.98	51.52	52.00	52.17	52.96	MH203-MH206
3	2	51.547	0.18	0.97	0.83	0.15	0.65	5.0	6.1	9.5	6.19	9.74	6.00	15	1.94	52.00	53.00	52.96	54.00	MH206-CCB213
4	3	134.701	0.02	0.79	0.54	0.01	0.50	5.0	5.6	9.6	4.85	6.03	4.88	15	0.74	53.00	54.00	54.00	54.89	CCB213-YD215
5	4	9.877	0.21	0.21	0.58	0.12	0.12	5.0	5.0	9.8	1.20	3.30	6.41	8	6.38	59.00	59.63	59.28	60.15	YD215-TRENCH
6	4	99.081	0.25	0.56	0.37	0.09	0.37	5.0	5.3	9.7	3.62	3.88	5.09	12	1.01	54.00	55.00	54.89	55.81	YD215-YD216
7	6	74.353	0.31	0.31	0.90	0.28	0.28	5.0	5.0	9.8	2.74	3.85	4.31	12	1.00	55.00	55.74	55.81	56.45	YD216-YD217
																		Number of lines: 7		Run Date: 12/6/2018

Project File: 100yr Yard Drain.stm

NOTES: Intensity = $127.16 / (\text{Inlet time} + 17.80)^{0.82}$; Return period = Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Inlet Time Tabulation

Page 1

Line No.	Line ID	Tc	Sheet Flow			Shallow Concentrated Flow			Channel Flow			Total Travel Time (min)				
			Method	n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	Ave Surf Descr	Water Slope (%)	X-sec Area (sqft)	Wetted Perim (ft)	n-Value	Vel	flow Length (ft)	Travel Time (min)
1	OCS202-MH203	User														0.00
2	MH203-MH206	User														0.00
3	MH206-CCB213	User														5.00
4	CCB213-YD215	User														5.00
5	YD215-TRENCHDRAIN	User														5.00
6	YD215-YD216	User														5.00
7	YD216-YD217	User														5.00

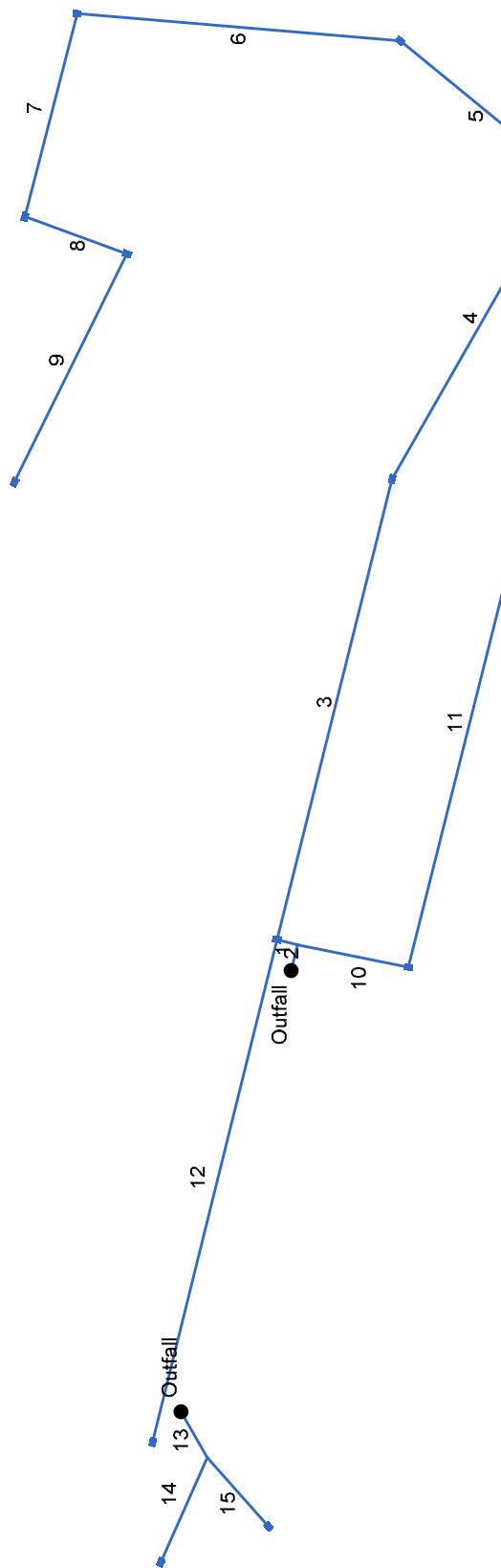
Project File: 100yr Yard Drain.stm

Min. Tc used for intensity calculations = 5 min

Number of lines: 7

Date: 12/6/2018

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: South.stm

Number of lines: 15

Date: 12/28/2018

Storm Sewer Inventory Report

Line No.	Alignment			Flow Data				Physical Data				Line ID					
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drg Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Line Size (in)	N Value (n)	J-Loss Coeff (K)	Inlet Rim El (ft)			
1	End	12.811	14.081	MH	0.00	0.00	0.00	0.0	45.50	0.00	45.50	24	Cir	0.012	1.00	50.74	OCS-106-MH107
2	1	10.306	-90.000	Comb	0.00	0.79	0.88	5.0	45.50	0.97	45.60	18	Cir	0.012	2.25	51.42	MH107-CCB110
3	2	231.287	90.011	Comb	0.00	0.65	0.84	5.0	45.60	0.67	47.16	18	Cir	0.012	0.50	51.20	CCB110-CCB112
4	3	170.136	15.777	Comb	0.00	0.11	0.55	5.0	47.16	0.49	48.00	18	Cir	0.012	1.48	51.51	CCB112-CCB113
5	4	104.147	-80.752	DrGrt	0.00	0.50	0.73	5.0	48.00	0.96	49.00	12	Cir	0.012	0.93	53.50	CCB113-YD114
6	5	158.471	-34.313	DrGrt	0.00	0.17	0.31	5.0	49.00	0.63	50.00	12	Cir	0.012	1.48	62.60	YD114-YD115
7	6	102.120	-80.287	DrGrt	0.00	0.32	0.34	5.0	50.00	1.96	52.00	12	Cir	0.015	1.49	64.56	YD115-YD116
8	7	53.100	-84.473	DrGrt	0.00	0.12	0.35	5.0	52.00	3.01	53.60	8	Cir	0.012	1.50	66.19	YD116-YD117
9	8	124.000	96.318	DrGrt	0.00	0.17	0.42	5.0	53.60	0.56	54.30	8	Cir	0.012	1.00	57.00	YD117-EXYD
10	1	55.248	87.309	Comb	0.00	0.40	0.87	5.0	45.50	0.51	45.78	18	Cir	0.012	1.50	49.56	MH107-CCB108
11	10	231.203	-87.214	Comb	0.00	0.49	0.86	5.0	45.78	0.53	47.00	15	Cir	0.015	1.00	49.50	CCB108-CCB109
12	2	251.958	-90.102	Comb	0.00	0.23	0.77	5.0	45.60	0.75	47.50	12	Cir	0.012	1.00	51.11	CCB110-CCB111
13	End	25.839	149.900	None	0.00	0.00	0.00	0.0	45.50	0.77	45.70	15	Cir	0.012	0.84	49.20	OCS102-MH103
14	13	55.790	54.211	Comb	0.00	0.46	0.80	5.0	45.70	0.54	46.00	12	Cir	0.012	1.00	49.00	MH103-CCB105
15	13	44.923	-11.645	Comb	0.00	0.22	0.84	5.0	45.70	0.67	46.00	8	Cir	0.012	1.00	48.80	MH103-CCB104
													Number of lines: 15	Date: 12/28/2018			
													Project File: South.stm				

Structure Report

Page 1

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	STM MH-107	Manhole	50.74	Cir	0.00	0.00	24	Cir	45.50	18	Cir	45.50
2	CCB-110	Combination	51.42	Rect	4.00	3.00	18	Cir	45.60	18	Cir	45.60
3	CCB-112	Combination	51.20	Rect	4.00	3.00	18	Cir	47.16	18	Cir	47.16
4	CCB-113	Combination	51.51	Rect	4.00	3.00	18	Cir	48.00	12	Cir	48.00
5	YD-114	DropGrate	53.50	Rect	4.00	3.00	12	Cir	49.00	12	Cir	49.00
6	YD-115	DropGrate	62.60	Rect	4.00	3.00	12	Cir	50.00	12	Cir	50.00
7	YD-116	DropGrate	64.56	Rect	4.00	3.00	12	Cir	52.00	8	Cir	52.00
8	YD-117	DropGrate	66.19	Rect	4.00	3.00	8	Cir	53.60	8	Cir	53.60
9	CONNECT TO EX YD			DropGrate	57.00	Rect	4.00	3.00	8	Cir	54.30	
10	CCB-108	Combination	49.56	Rect	4.00	3.00	18	Cir	45.78	15	Cir	45.78
11	CCB-109	Combination	49.50	Rect	4.00	3.00	15	Cir	47.00			
12	CCB-111	Combination	51.11	Rect	4.00	3.00	12	Cir	47.50			
13	MH-103	None	49.20	n/a	n/a	15	Cir	45.70	12	Cir	45.70	
14	CCB-105	Combination	49.00	Rect	4.00	3.00	12	Cir	46.00			
15	CCB-104	Combination	48.80	Rect	4.00	3.00	8	Cir	46.00			

Project File: South.stm

Number of Structures: 15

Run Date: 12/28/2018

Storm Sewer Summary Report

Page 1

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	OCS-106-MH107	17.16	24	Cir	12.811	45.50	0.000	47.32	47.40	0.48	47.88	End	Manhole	
2	MH107-CCB110	12.60	18	Cir	10.306	45.50	45.60	0.970	47.88*	48.01*	1.78	49.79	1	Combination
3	CCB110-CCB112	7.63	18	Cir	231.287	45.60	47.16	0.674	49.79*	50.83*	0.14	50.98	2	Combination
4	CCB112-CCB113	4.46	18	Cir	170.136	47.16	48.00	0.494	50.98*	51.24*	0.15	51.38	3	Combination
5	CCB113-YD114	4.12	12	Cir	104.147	48.00	49.00	0.960	51.38*	52.57*	0.40	52.97	4	DropGrate
6	YD114-YD115	1.84	12	Cir	158.471	49.00	50.00	0.631	52.97*	53.33*	0.13	53.46	5	DropGrate
7	YD115-YD116	1.54	12	Cir	102.120	50.00	52.00	1.958	53.46*	53.71*	0.09	53.80	6	DropGrate
8	YD116-YD117	0.80	8	Cir	53.100	52.00	53.60	3.013	53.80	54.02	n/a	54.29 j	7	DropGrate
9	YD117-EXYD	0.52	8	Cir	124.000	53.60	54.30	0.565	54.29	54.64	0.13	54.77	8	DropGrate
10	MH107-CCB108	5.24	18	Cir	55.248	45.50	45.78	0.507	47.88*	48.00*	0.21	48.21	1	Combination
11	CCB108-CCB109	3.05	15	Cir	231.203	45.78	47.00	0.528	48.21*	48.89*	0.10	48.99	10	Combination
12	CCB110-CCB111	1.28	12	Cir	251.958	45.60	47.50	0.754	49.79*	50.07*	0.04	50.11	2	Combination
13	OCS102-MH103	3.96	15	Cir	25.839	45.50	45.70	0.774	47.32*	47.40*	0.14	47.54	End	None
14	MH103-CCB105	2.66	12	Cir	55.790	45.70	46.00	0.538	47.54*	47.80*	0.18	47.98	13	Combination
15	MH103-CCB104	1.34	8	Cir	44.923	45.70	46.00	0.668	47.54*	48.01*	0.23	48.24	13	Combination
													Number of lines: 15	Run Date: 12/28/2018

Project File: South.sbm

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Line	Station	Len	Drng Area		Area x C		Tc		Rain (I)		Total flow	Cap full	Vel	Pipe	Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID	
			Incr	Total	Incr	Total	Inlet	Syst	(min)	(in/hr)					Size	Slope (%)	Dn	Up	(ft)	(ft)		
1	End	12.811	0.00	3.95	0.00	0.00	2.89	0.0	10.5	5.9	17.16	0.00	5.64	24	0.00	45.50	45.50	47.32	47.40	50.87	50.74	OCS-106-MH107
2	1	10.306	0.79	3.06	0.88	0.70	2.12	5.0	10.5	5.9	12.60	11.21	7.13	18	0.97	45.50	45.60	47.88	48.01	50.74	51.42	MH107-CCB110
3	2	231.287	0.65	2.04	0.84	0.55	1.25	5.0	9.6	6.1	7.63	9.34	4.32	18	0.67	45.60	47.16	49.79	50.83	51.42	51.20	CCB110-CCB112
4	3	170.136	0.11	1.39	0.55	0.06	0.70	5.0	8.5	6.4	4.46	7.99	2.52	18	0.49	47.16	48.00	50.98	51.24	51.20	51.51	CCB112-CCB113
5	4	104.147	0.50	1.28	0.73	0.37	0.64	5.0	8.1	6.4	4.12	3.78	5.24	12	0.96	48.00	49.00	51.38	52.57	51.51	53.50	CCB113-YD114
6	5	158.471	0.17	0.78	0.31	0.05	0.27	5.0	7.0	6.7	1.84	3.06	2.35	12	0.63	49.00	50.00	52.97	53.33	53.50	62.60	YD114-YD115
7	6	102.120	0.32	0.61	0.34	0.11	0.22	5.0	6.1	6.9	1.54	4.32	1.96	12	1.96	50.00	52.00	53.46	53.71	62.60	64.56	YD115-YD116
8	7	53.100	0.12	0.29	0.35	0.04	0.11	5.0	5.8	7.0	0.80	2.27	2.84	8	3.01	52.00	53.60	53.80	54.02	64.56	66.19	YD116-YD117
9	8	124.000	0.17	0.17	0.42	0.07	0.07	5.0	5.0	7.2	0.52	0.98	2.16	8	0.56	53.60	54.30	54.29	54.64	66.19	57.00	YD117-EXYD
10	1	55.248	0.40	0.89	0.87	0.35	0.77	5.0	6.6	6.8	5.24	8.10	2.97	18	0.51	45.50	45.78	47.88	48.00	50.74	49.56	MH107-CCB108
11	10	231.203	0.49	0.49	0.86	0.42	0.42	5.0	5.0	7.2	3.05	4.07	2.49	15	0.53	45.78	47.00	48.21	48.89	50.07	51.42	CCB108-CCB109
12	2	251.958	0.23	0.23	0.77	0.18	0.18	5.0	5.0	7.2	1.28	3.35	1.63	12	0.75	45.60	47.50	49.79	50.07	51.42	51.11	CCB110-CCB111
13	End	25.839	0.00	0.68	0.00	0.00	0.55	0.0	5.3	7.2	3.96	6.15	3.23	15	0.77	45.50	45.70	47.32	47.40	49.20	49.20	OCS102-MH103
14	13	55.790	0.46	0.46	0.80	0.37	0.37	5.0	5.0	7.2	2.66	2.83	3.39	12	0.54	45.70	46.00	47.54	47.80	49.20	49.00	MH103-CCB105
15	13	44.923	0.22	0.22	0.84	0.18	0.18	5.0	5.0	7.2	1.34	1.07	3.83	8	0.67	45.70	46.00	47.54	48.01	49.20	48.80	MH103-CCB104
																			Number of lines: 15		Run Date: 12/28/2018	

Project File: South.stm

NOTES:Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period = Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Inlet Time Tabulation

Page 1

Line No.	Line ID	Tc	Sheet Flow			Shallow Concentrated Flow			Channel Flow			Total Travel Time (min)
			Method	n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	Ave Surf Descr	Water Slope (%)	X-sec Area (sqft)	
1	OCS-106-MH107	User										
2	MH107-CCB110	User										0.00
3	CCB110-CCB112	User										5.00
4	CCB112-CCB113	User										5.00
5	CCB113-YD114	User										5.00
6	YD114-YD115	User										5.00
7	YD115-YD116	User										5.00
8	YD116-YD117	User										5.00
9	YD117-EXYD	User										5.00
10	MH107-CCB108	User										5.00
11	CCB108-CCB109	User										5.00
12	CCB110-CCB111	User										5.00
13	OCS102-MH103	User										0.00
14	MH103-CCB105	User										5.00
15	MH103-CCB104	User										5.00

Project File: South.stm

Min. Tc used for intensity calculations = 5 min

Number of lines: 15

Date: 12/28/2018

Project: North System Isolator Row

Chamber Model -
Units -

SC-740
Imperial



Number of chambers - 44
Voids in the stone (porosity) - 40 %
Base of Stone Elevation - 47.25 ft
Amount of Stone Above Chambers - 6 in
Amount of Stone Below Chambers - 6 in

1487

Include Perimeter Stone in Calculations

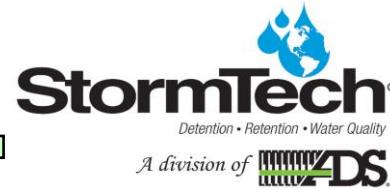
StormTech SC-740 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Total Chamber (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch & St (cubic feet)	Cumulative Chamber (cubic feet)	Elevation (feet)
42	0.00	0.00	49.58	49.58	3295.44	50.75
41	0.00	0.00	49.58	49.58	3245.86	50.67
40	0.00	0.00	49.58	49.58	3196.28	50.58
39	0.00	0.00	49.58	49.58	3146.70	50.50
38	0.00	0.00	49.58	49.58	3097.12	50.42
37	0.00	0.00	49.58	49.58	3047.54	50.33
36	0.05	2.42	48.61	51.03	2997.96	50.25
35	0.16	7.17	46.71	53.88	2946.93	50.17
34	0.28	12.41	44.62	57.02	2893.05	50.08
33	0.60	26.57	38.95	65.52	2836.03	50.00
32	0.80	35.28	35.47	70.74	2770.50	49.92
31	0.95	41.83	32.85	74.68	2699.76	49.83
30	1.07	47.28	30.67	77.95	2625.08	49.75
29	1.18	51.94	28.80	80.74	2547.14	49.67
28	1.27	55.69	27.30	82.99	2466.39	49.58
27	1.36	59.62	25.73	85.35	2383.40	49.50
26	1.45	63.98	23.99	87.97	2298.05	49.42
25	1.52	67.09	22.74	89.83	2210.08	49.33
24	1.58	69.62	21.73	91.35	2120.25	49.25
23	1.64	72.26	20.68	92.94	2028.89	49.17
22	1.70	74.78	19.67	94.45	1935.96	49.08
21	1.75	77.13	18.73	95.86	1841.51	49.00
20	1.80	79.32	17.85	97.17	1745.65	48.92
19	1.85	81.62	16.93	98.55	1648.48	48.83
18	1.89	83.30	16.26	99.56	1549.93	48.75
17	1.93	85.10	15.54	100.64	1450.37	48.67
16	1.97	86.90	14.82	101.72	1349.74	48.58
15	2.01	88.44	14.20	102.64	1248.02	48.50
14	2.04	89.98	13.59	103.57	1145.37	48.42
13	2.07	91.30	13.06	104.36	1041.81	48.33
12	2.10	92.62	12.53	105.15	937.45	48.25
11	2.13	93.80	12.06	105.86	832.30	48.17
10	2.15	94.77	11.67	106.44	726.44	48.08
9	2.18	95.79	11.26	107.05	620.00	48.00
8	2.20	96.73	10.89	107.62	512.95	47.92
7	2.21	97.12	10.73	107.85	405.33	47.83
6	0.00	0.00	49.58	49.58	297.48	47.75
5	0.00	0.00	49.58	49.58	247.90	47.67
4	0.00	0.00	49.58	49.58	198.32	47.58
3	0.00	0.00	49.58	49.58	148.74	47.50
2	0.00	0.00	49.58	49.58	99.16	47.42
1	0.00	0.00	49.58	49.58	49.58	47.33

Project: South System Isolator Row

Chamber Model -
Units -

SC-740
Imperial [Click Here for Metric](#)



Number of chambers -
Voids in the stone (porosity) -
Base of Stone Elevation -
Amount of Stone Above Chambers -
Amount of Stone Below Chambers -

30
40 %
43.75 ft
6 in
6 in

1020

Include Perimeter Stone in Calculations

StormTech SC-740 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Total Chamber (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch & St (cubic feet)	Cumulative Chamber (cubic feet)	Elevation (feet)
42	0.00	0.00	33.80	33.80	2246.89	47.25
41	0.00	0.00	33.80	33.80	2213.09	47.17
40	0.00	0.00	33.80	33.80	2179.28	47.08
39	0.00	0.00	33.80	33.80	2145.48	47.00
38	0.00	0.00	33.80	33.80	2111.67	46.92
37	0.00	0.00	33.80	33.80	2077.87	46.83
36	0.05	1.65	33.14	34.79	2044.07	46.75
35	0.16	4.89	31.85	36.74	2009.27	46.67
34	0.28	8.46	30.42	38.88	1972.53	46.58
33	0.60	18.12	26.56	44.68	1933.66	46.50
32	0.80	24.05	24.18	48.24	1888.98	46.42
31	0.95	28.52	22.40	50.92	1840.74	46.33
30	1.07	32.24	20.91	53.15	1789.83	46.25
29	1.18	35.41	19.64	55.05	1736.68	46.17
28	1.27	37.97	18.62	56.59	1681.63	46.08
27	1.36	40.65	17.54	58.19	1625.04	46.00
26	1.45	43.62	16.35	59.98	1566.85	45.92
25	1.52	45.74	15.51	61.25	1506.87	45.83
24	1.58	47.47	14.82	62.29	1445.62	45.75
23	1.64	49.27	14.10	63.37	1383.34	45.67
22	1.70	50.99	13.41	64.40	1319.97	45.58
21	1.75	52.59	12.77	65.36	1255.58	45.50
20	1.80	54.08	12.17	66.25	1190.22	45.42
19	1.85	55.65	11.54	67.19	1123.96	45.33
18	1.89	56.79	11.09	67.88	1056.77	45.25
17	1.93	58.02	10.60	68.62	988.89	45.17
16	1.97	59.25	10.10	69.35	920.27	45.08
15	2.01	60.30	9.69	69.98	850.92	45.00
14	2.04	61.35	9.26	70.61	780.94	44.92
13	2.07	62.25	8.90	71.15	710.32	44.83
12	2.10	63.15	8.55	71.69	639.17	44.75
11	2.13	63.95	8.22	72.18	567.48	44.67
10	2.15	64.62	7.96	72.57	495.30	44.58
9	2.18	65.31	7.68	72.99	422.73	44.50
8	2.20	65.95	7.42	73.37	349.74	44.42
7	2.21	66.22	7.32	73.54	276.36	44.33
6	0.00	0.00	33.80	33.80	202.83	44.25
5	0.00	0.00	33.80	33.80	169.02	44.17
4	0.00	0.00	33.80	33.80	135.22	44.08
3	0.00	0.00	33.80	33.80	101.41	44.00
2	0.00	0.00	33.80	33.80	67.61	43.92
1	0.00	0.00	33.80	33.80	33.80	43.83

Chamber Model - SC-740
 Units - Imperial

[Click Here for Metric](#)

 Number of chambers - 286
 Voids in the stone (porosity) - 40 %
 Base of Stone Elevation - 46.75 ft
 Amount of Stone Above Chambers - 6 in
 Amount of Stone Below Chambers - 6 in
 Area of system - 10706 sf

 286
 40 %
 46.75 ft
 6 in
 6 in
 10706 sf

 Include Perimeter Stone in Calculations

 Min. Area - [9668 sf](#) min. area

StormTech SC-740 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Total Chamber (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch & St (cubic feet)	Cumulative Chamber (cubic feet)	Elevation (feet)
42	0.00	0.00	356.87	356.87	22873.56	50.25
41	0.00	0.00	356.87	356.87	22516.70	50.17
40	0.00	0.00	356.87	356.87	22159.83	50.08
39	0.00	0.00	356.87	356.87	21802.96	50.00
38	0.00	0.00	356.87	356.87	21446.10	49.92
37	0.00	0.00	356.87	356.87	21089.23	49.83
36	0.05	15.73	350.58	366.30	20732.36	49.75
35	0.16	46.59	338.23	384.82	20366.06	49.67
34	0.28	80.64	324.61	405.25	19981.24	49.58
33	0.60	172.73	287.77	460.51	19575.99	49.50
32	0.80	229.29	265.15	494.44	19115.48	49.42
31	0.95	271.89	248.11	520.00	18621.04	49.33
30	1.07	307.31	233.94	541.25	18101.04	49.25
29	1.18	337.62	221.82	559.44	17559.79	49.17
28	1.27	361.98	212.08	574.05	17000.35	49.08
27	1.36	387.53	201.85	589.39	16426.29	49.00
26	1.45	415.87	190.52	606.39	15836.91	48.92
25	1.52	436.07	182.44	618.51	15230.52	48.83
24	1.58	452.55	175.85	628.39	14612.01	48.75
23	1.64	469.69	168.99	638.68	13983.61	48.67
22	1.70	486.06	162.44	648.50	13344.93	48.58
21	1.75	501.34	156.33	657.67	12696.43	48.50
20	1.80	515.60	150.62	666.23	12038.76	48.42
19	1.85	530.53	144.65	675.18	11372.53	48.33
18	1.89	541.42	140.30	681.72	10697.35	48.25
17	1.93	553.13	135.62	688.74	10015.62	48.17
16	1.97	564.85	130.93	695.78	9326.88	48.08
15	2.01	574.84	126.93	701.77	8631.11	48.00
14	2.04	584.87	122.92	707.79	7929.34	47.92
13	2.07	593.44	119.49	712.93	7221.55	47.83
12	2.10	602.01	116.06	718.07	6508.62	47.75
11	2.13	609.69	112.99	722.68	5790.55	47.67
10	2.15	616.00	110.47	726.47	5067.87	47.58
9	2.18	622.64	107.81	730.45	4341.40	47.50
8	2.20	628.73	105.37	734.10	3610.95	47.42
7	2.21	631.30	104.35	735.64	2876.84	47.33
6	0.00	0.00	356.87	356.87	2141.20	47.25
5	0.00	0.00	356.87	356.87	1784.33	47.17
4	0.00	0.00	356.87	356.87	1427.47	47.08
3	0.00	0.00	356.87	356.87	1070.60	47.00
2	0.00	0.00	356.87	356.87	713.73	46.92
1	0.00	0.00	356.87	356.87	356.87	46.83

Chamber Model -
 Units -

SC-740
Imperial
Click Here for Metric

 Number of chambers -
 Voids in the stone (porosity) -
 Base of Stone Elevation -
 Amount of Stone Above Chambers -
 Amount of Stone Below Chambers -
 Area of system -

360
40
43.25
6
6
13650

%

ft

in

 Include Perimeter Stone in Calculations

 sf Min. Area - **12170 sf min. area**
StormTech SC-740 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Total Chamber (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch & St (cubic feet)	Cumulative Chamber (cubic feet)	Elevation (feet)
42	0.00	0.00	455.00	455.00	29035.38	46.75
41	0.00	0.00	455.00	455.00	28580.38	46.67
40	0.00	0.00	455.00	455.00	28125.38	46.58
39	0.00	0.00	455.00	455.00	27670.38	46.50
38	0.00	0.00	455.00	455.00	27215.38	46.42
37	0.00	0.00	455.00	455.00	26760.38	46.33
36	0.05	19.80	447.08	466.88	26305.38	46.25
35	0.16	58.65	431.54	490.19	25838.50	46.17
34	0.28	101.50	414.40	515.90	25348.31	46.08
33	0.60	217.43	368.03	585.46	24832.41	46.00
32	0.80	288.62	339.55	628.17	24246.96	45.92
31	0.95	342.24	318.10	660.35	23618.79	45.83
30	1.07	386.83	300.27	687.10	22958.44	45.75
29	1.18	424.98	285.01	709.99	22271.35	45.67
28	1.27	455.64	272.75	728.38	21561.36	45.58
27	1.36	487.80	259.88	747.68	20832.98	45.50
26	1.45	523.48	245.61	769.09	20085.30	45.42
25	1.52	548.90	235.44	784.34	19316.21	45.33
24	1.58	569.64	227.15	796.78	18531.87	45.25
23	1.64	591.22	218.51	809.73	17735.09	45.17
22	1.70	611.83	210.27	822.10	16925.35	45.08
21	1.75	631.05	202.58	833.63	16103.26	45.00
20	1.80	649.01	195.40	844.41	15269.63	44.92
19	1.85	667.80	187.88	855.68	14425.22	44.83
18	1.89	681.51	182.40	863.91	13569.54	44.75
17	1.93	696.24	176.50	872.75	12705.63	44.67
16	1.97	711.00	170.60	881.60	11832.89	44.58
15	2.01	723.57	165.57	889.14	10951.29	44.50
14	2.04	736.20	160.52	896.72	10062.14	44.42
13	2.07	746.99	156.21	903.19	9165.43	44.33
12	2.10	757.77	151.89	909.66	8262.23	44.25
11	2.13	767.45	148.02	915.47	7352.57	44.17
10	2.15	775.39	144.85	920.23	6437.11	44.08
9	2.18	783.74	141.50	925.25	5516.87	44.00
8	2.20	791.41	138.44	929.85	4591.63	43.92
7	2.21	794.64	137.15	931.78	3661.78	43.83
6	0.00	0.00	455.00	455.00	2730.00	43.75
5	0.00	0.00	455.00	455.00	2275.00	43.67
4	0.00	0.00	455.00	455.00	1820.00	43.58
3	0.00	0.00	455.00	455.00	1365.00	43.50
2	0.00	0.00	455.00	455.00	910.00	43.42
1	0.00	0.00	455.00	455.00	455.00	43.33

APPENDIX D
Stormwater Quality Calculations

STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1'')(R)(A)}{12}$$

WQV= water quality volume (*acre-feet*)

R= volumetric runoff coefficient

I = percent impervious cover

A= site area (*acres*)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (*cfs*)

q_u= unit peak discharge (*cfs/m²/inch*)

A= drainage area (*m²*)

Q= runoff depth (*watershed inches*)

$$= \frac{[WQV \text{ (acre-feet)}] \times [12 \text{ (inches/foot)}]}{\text{Drainage area (acres)}}$$

Site Characteristics (Water Quality Unit - PR-A1)

Area 3.44 acres 0.005375 mi²

Impervious Area 2.47 acres

I 71.8 %

R = 0.05+ 0.009(I) = 0.696

WQV= **0.20 acre-ft** 8,694 cf

P=Precipitation 1 inch

Ia=Initial Abstraction 0.284

Tc=Time of Concentration 8 minutes 0.133333 hours

Qu=unit peak discharge (*Exhibit 4-III*) 575 cfs/mi²/inch

A=Drainage Area 3.44 acres 0.005375 mi²

Q=Runoff Depth 0.7 watershed inches

WQF= **2.15 cfs**

One Park Road	BY	JM	DATE	12/06/20183	PROJ NO.	140184201
West Hartford, CT	CKD		DATE		SHEET	1 of 1

STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1'')(R)(A)}{12}$$

WQV= water quality volume (*acre-feet*)

R= volumetric runoff coefficient

I = percent impervious cover

A= site area (*acres*)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (*cfs*)

q_u= unit peak discharge (*cfs/m²/inch*)

A= drainage area (*m²*)

Q= runoff depth (*watershed inches*)

$$= \frac{[WQV \text{ (acre-feet)}] \times [12 \text{ (inches/foot)}]}{\text{Drainage area (acres)}}$$

Site Characteristics (Water Quality Unit - PR-A1)

Area	4.62 acres	0.007219 mi^2
<i>Impervious Area</i>	3.39 acres	
<i>I</i>	73.4 %	
<i>R</i> = 0.05+ 0.009(<i>I</i>) =	0.710	

WQV= **0.27 acre-ft** **11,914 cf**

<i>P</i> =Precipitation	1 inch	
<i>Ia</i> =Initial Abstraction	0.269	
<i>Tc</i> =Time of Concentration	12 minutes	0.2 hours

<i>Qu</i> =unit peak discharge (<i>Exhibit 4-III</i>)	575 cfs/mi^2/inch	
<i>A</i> =Drainage Area	4.62 acres	0.007219 mi^2
<i>Q</i> =Runoff Depth	0.7 watershed inches	

WQF= **2.95 cfs**

One Park Road	BY	JM	DATE	12/6/2018	PROJ NO.	140184201
West Hartford, CT	CKD		DATE		SHEET	1 of 1